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An Excellent Shop Photograph.

We get, in this office, all kinds of photographs taken in machine shops. Most of them are merely indifferent, but too many are very bad; while occasionally we are gladdened by the reception of a really good one. The best shop photograph we have ever seen we have endeavored to reproduce by the accompanying engraving, which has been made without brush work or other doctoring, with the special object of showing, as well as can be done by the half-tone process, what is possible of attainment in a shop photograph.

This photograph would be an exceptionally good one, even if no men were in it, or if, what is far worse, they stood in attitudes plainly betraying their knowledge that they were "being took." It is remarkable for its detail, depth and uniformity.

The shop shown is that of Dean Bros., Steam Pump Works, Indianapolis, and the photograph was taken by a professional photographer at about 11 A. M., when there was a hazy cloud over the sun, the shop being lighted as usual—i. e., no light was shut out or modified in any way. The camera used was Anthony's "Fairy"; lens, Dallmeyer's "Rapid Rectilinear"; plate, Cramer's "Lightning." The camera was about 20 feet above the floor. The room shown is 60 x 375 feet.

A GOOD SHOP PHOTOGRAPH.

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Secretary Long has directed that the use of non-inflammable wood in the construction of warships shall be stopped for the present. This wood has been used in planking decks and in furnishing the living quarters of the ships. The wood will not take paint readily, and, owing to the chemicals with which it is treated, it easily disintegrates and corrodes all metals with which it is in contact. The "Iowa," the latest of our battleships, and the "Helena," one of the new gunboats, are fitted with non-inflammable wood, which is enough for the present. The non-inflammable feature is an extremely desirable one, as was demonstrated by its absence in the ships employed in the late conflict between China and Japan.

Small Error Limits in Large Lathes.

BY JOHN RANDOL.

A small engine lathe for tool-makers' use should be without detrimental errors. It should turn a true cylinder, bore a straight hole and face flat across. It should also have a lead screw of standard and uniform pitch, and should have its head and foot spindles in line.

But what is the limit of error allowable in a 16-inch tool-maker's lathe? We all know perfectly well that there is not a lathe in the open market which is without errors. We also know that none of our lathes can be moved from the place where they are inspected and show precisely the same errors at a second inspection.

We know, too, that if we take an indicator, in which the index moves somewhere about 1-16 inch visible travel over the index graduations for 1-1000 inch actual variation in the surface traversed by the contact, we will find no machine tools in the ordinary shop which do not show an abundance of errors all over. But with all these errors in our tools, we can produce good work, work which fills its purpose and is satisfactory to all concerned. Why, then, should we seek tools which are said to be true, or concern ourselves at all in the matter of "true" or "out of true" machine tools? Reference is made more particularly to lathes, as the truth of no other tool is of so much importance. No planers have accurately straight V- or flat ways, or flat tables. If we place an indicator in the tool post of any planer, no matter of whose make, and run the table under it in contact, the indicator index doesn't stand still by a long way. The cylindrical grinding machine can be adjusted all over. The drilling machine we never expect to be true, and as for the slotter and shaper, we know their work is always faulty, and expect to re-finish surfaces produced by these tools if they are to approach accuracy. In short, we have no perfect tools, and turn out no perfect work; we do not need accurate work in commercial machines, except for comparison of lengths and diameters, and if we try to make these standard-measurement tools, of which there are perhaps not a dozen in existence, and which not one machinist in ten thousand has even seen, while the vast majority of operative mechanics are not aware that such things exist—if we try to make these standard-measurement tools exact, many months must be consumed in tests after the machines are completed, and then the approximation to correctness is assumed to be the average of the errors disclosed by different inspections.

It is quite evident from all this that we absolutely cannot produce perfect lathes. We all know, too, that we cannot profitably use lathes in which the error limit exceeds bounds set by the work which the lathes are to produce. In certain classes of work accuracy is needless, and these classes include enormous numbers of machines. An ordinary cotton loom sells for $35 or $40, and has considerable lathe work on it. None of that lathe work is anywhere near true; but cotton looms are adapted to their purpose, and if they could be improved by better work, that better work would be found on them. Hence lathes that are perfectly suitable for the production of certain parts of textile machinery may involve errors which would make it absolutely impossible to use them for tool-maker's lathes. At the Mason Machine Shop, Taunton, I saw lathes at work on small gear blanks which should have been in the scrap heap thirty years before. A leading firm of automatic machine tool builders put in a magnificent special tool for this work, and took it out again because the scrap-heap antiquities, with their cheap operators, could do the work good enough for less money.

Commercially and practically speaking, our American tool-maker's lathes are admirable creations, nothing less than operative perfection so far as accurate workmanship is concerned. Consequently there is a certain limit of error which may be embodied in lathes suitable for work of the highest class, and the only thing of importance to lathe buyers is to know the limit for the various parts of lathes of different sizes.

Granting this, it follows at once that the error allowable must be much greater in large lathes than in small. Suppose a 16-inch lathe is allowed a limit of 0.0005 inch in facing flat over the extreme diameter, then a lathe to face over 64 inches diameter having the same accuracy of construction in the facing parts would show an error of 0.002 inch in the work produced.

But the whole practice of the modern machine shop tends towards fixed measurements. Perfection is well known to be impossible, and consequently the permissible error dimension must be made specific. In the old practice if a purchaser desired a good lathe or good castings or good forgings he went to a lathe maker of good reputation and ordered a lathe of the desired dimensions, "built in a good and workman-like manner," or to a favorably known foundry and ordered castings "sound and true to pattern," or to a forge master and ordered forgings made of Low Moor, or Bowling, or Sweeds, or Ulster iron, "smooth and true to drawings furnished," trusting to reputation for all else. Now the foundry and the forge depend on their chemist, and the customer depends on his chemist and the testing machine, and the lathe buyer may order as of yore by the reputation of the lathe maker, or he may send a list of permissible errors with his order, and specify in inch measurements what he will accept.

In a recent case, two 60-inch lathes of the same dimensions and details were ordered of the same builder.

Of these two lathes, one was ordered by the South Brooklyn Dry Dock, on the reputation of the builder. The other was ordered by the Builder's Iron Foundry, of Providence, the order being accompanied by a minute detail of error-limits. Both of these orders have been filled, both customers are delighted with their new lathes, which are extremely fine tools, perfectly suitable for their work, and the Providence lathe cost twice as much for finishing as the South Brooklyn lathe.

Was this excess of cost money well spent?

The list of error limits and instruction furnished by the Builder's Iron Foundry is as follows:

1. Center hole in live spindle to run true; limit 0.0005 inch at end of spindle and 0.002 inch at end of test bar; test bar 24 inches long.

2. Head-stock spindle to be in line with ways of bed; limit in both horizontal and vertical planes, 0.0005 inch in 24 inches. Error if any must make nose of spindle stand back of center line. (Making the lathe bore face plate work large outside.)

3. Foot-stock spindle to be in line with ways; limit in both planes 0.0001 inch, in 12 inches, on test bar.

4. Foot stock spindle to line with ways of the bed; limit in vertical plane, 0.002 inch high, nothing under.

5. Travel of foot-stock spindle to be parallel with ways; limit 0.001 inch in 12 inch travel.

6. Foot stock to line with head when in different positions on bed; limit in horizontal plane 0.002 inch.

7. Lathe to face square; limit 0.002 inch in diameter of face plate (60 inches).

8. Lead screw standard pitch, limit 0.002 inch in 12 inches.

11. Vertical surface on back of bed must show straight under the straight edge. (No limit.)

12. Vertical plane surface on front of bed must test parallel with corresponding surface on back of bed with straight edge and micrometer wire.

13. Bed must test everywhere in horizontal plane. (The lathe has a flat bed, without V's.)

These instructions continue up to 45 in number. Those omitted would be included in the "workmanlike manner" of old style specifications, and point out details to be considered in the purchaser's inspection for acceptance.

In the shops of the builder this lathe bed was placed for erection on the finished cast-iron erecting floor surfaces, and there assembled and tested and inspected with a rigidity well illustrated by the following occurrence:

The centers are about 4 inches—large diameter of the taper. The center reamer was that in common use for 60-inch lathes, and was not so sharp as it might well have been, and made a little mark, a narrow ring of rough surface, well inside of the center seat in the foot-stock spindle.

Objection was made, and as this roughness was barely perceptible, and of no appreciable depth, the reamer was stoned up and the roughness was removed by hand, without removing the spindle from the foot stock. This spindle had previously tested within the limits in every way. Hand reaming the center-seat caused a very slight drop in the point of the center. As this was not allowable, and was so very little, the rear end of the bottom of the foot stock was scraped down to tip the point of the center up. This lifted the center up but brought the foot-spindle traverse variation outside the limit specified. The foot stock bottom surface was therefore brought back parallel with the foot spindle by scraping, which, of course, brought the foot-stock spindle too low for the head spindle, so that the head-stock foot had to be all scraped over to bring the head spindle down to the foot spindle level. The tail spindle was taken to the lathe and had the center seat rebored and re-reamed.

The small error limits and rigidity of tests met, caused, as previously stated, a labor cost double that of the sister lathe, which went to South Brooklyn.

It is the practice of the tool shop referred to to place such a lathe on bearing strips about 48 inches center to center, which makes it possible to adjust the foundation hight at different points and thus level the lathe bed exactly.

The Builder's Iron Foundry stands on a sea formation of small clean gravel which is perfectly stable, and this lathe was set on a continuous concrete foundation laid on the gravel, without means of local adjustment. The bed was set by leveling and is supposed to be perfectly true.

The lathe has been tested since placing it on its working foundation, and gives the same accuracy limit as in the Pond shops.

The South Brooklyn lathe is to be used in a general shop, on steam engine and mill work. The Providence lathe is to be used first on a considerable order for built up mortars for the government.

Suppose the Providence lathe to have, say 5 or 10 tons on the face-plate. Will the parts stand as they stand unloaded? Or suppose it has 10 or 15 tons on the centers, will it still retain its unloaded form?

As to the fine gravel foundation, no machine tool in the Builder's Iron Foundry has been observed to settle or move, and while it seems not unreasonable to suppose the possibility of local adjustment an essential to the foundations of long lathes of this size, and while it would also seem that to secure such a small variation limit in practice as was demanded in the construction of this lathe local adjustment of the bed position was indispensable, perhaps the Providence foundation is in every way sufficient.

The one broad question in the matter is whether the double labor cost was justified by real advantages gained, or not. The Builder's Iron Foundry can justly pride itself on the possession of a 60-inch lathe of such unprecedented accuracy, but is it not possible for the same man to do as much and as good work on the South Brooklyn lathe, built with no specification limits, as on the Providence lathe built with double the labor? If so, then the small inspection limit was a costly error. The variation limit on the Watervliet Arsenal lathes built by the Pond shops was 0.0025, throughout, and the performance of these lathes on built up gun-work has been perfectly satisfactory.

In regard to cost, it is well-known that in all classes of metal work any reduction of the error limit is certain to result in a seemingly altogether disproportionate advance in the labor cost, and this advance must in the nature of things be much greater in large work than in small work. Hence superintendents ordering large tools with small specified variation limits must be prepared to pay very large additions to the ordinary prices to cover extra work, and should be certain that the unusually near approach to accuracy will prove economical in spite of the increased expense, before making extraordinary demands on the skill and patience of the tool-builder.

We here in America are at this present time in what may not inappropriately be termed a spasm of precision, and are every one of us ready to fall down and worship at the shrine of the micrometer and adopt the shibboleth of "the quarter of a thousandth limit." Whether this is only a spasm going before the swing of the pendulum back again toward the old standard of "in a good and workmanlike manner," or the dawning of the real day of true mechanical excellence is now uncertain. As an old time machine hand, I remember when there was not a true square or a uniformly graduated scale in any shop, and a "half-a-sixty-fourth" was the smallest dimension mentioned. We did good work then, but we did not do so much of it in a day, and perhaps the "quarter of a thousandth" was what was lacking. I am, however, myself more inclined to believe that we lacked some inches in the diameter of our lathe spindles and some tons of cast iron in our machine tool frames much more than we lacked either in close measurement or close fitting, or in the mental power of adapting means to ends which is laid down in no book, engraved on no scale, but is after all the principal factor in successful machine production.

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The Johnson Steel Company, of Cleveland, has received orders for 20,000 tons of steel rails for electric roads in Ireland. The firm underbid not only American mills nearer the seaboard, but all the English concerns, as well.

Manufacturing Methods as Applied to the Production of Machinery.*

BY F. A. HALSEY.

(Concluded.)

Special fixtures have two uses—first, to secure interchangeability, and, second, to cheapen the product. Where interchangeability is essential, as with us, then up to the point where interchangeability is secured, which is not very far, the fixtures must be made without much regard to their cost; but where the object of the fixtures is to cheapen product, a relation exists between their cost and the saving which they accomplish. When pieces are produced in large numbers, much more expensive fixtures are justifiable than when the production is small. This seems very obvious, but it is much easier to recognize a general principle when standing off at a distance than it is to apply the principle to individual cases as they arise, and I have seen so many and such serious mistakes in this matter, that I know the point will bear some emphasis. In this matter it is my fixed opinion, heretical as it may seem, that underdoing is better than overdoing, and that of the two, an old fogy is a safer guide in these matters than an enthusiast, though both should be shunned. This work is so attractive, that unless the one in charge constantly asks himself the hard, cold question, "Will this thing pay?" his heart will simply run away with his head, and someone else will have some big bills to pay. These things are not made to gratify anyone's enthusiasm or love of orderly and systematic methods of procedure. Their sole purpose is to save money, and unless they do this to a degree commensurate with their cost, they are failures, regardless of how well they may operate from a mere mechanical point of view. The essential point is, that the system of manufacture must be based upon the output; in other words, upon sales. A system suitable to a large output cannot be economically employed upon a small output, as in addition to the question of investment, the element of "get ready time" which is involved in setting up highly organized special tools, becomes such a heavy charge when the production is small, as to defeat the entire purpose of the outfit. It is largely this element of "get ready time" which sets a limit to the applicability of manufacturing methods to production on a limited scale. From the nature of the case but little definite information on this topic can be put in words, as each case must be considered by itself. It is not often that parts can be made on the turret lathe in smaller lots than twenty-five with any ultimate saving, and there are more cases in which the limit is fifty pieces than twenty-five, though it should be said that recent improvements in these machines reduce the limit below its for-

* Introductory portion of a lecture before the mechanical engineering students of Cornell University.

mer value. Milling-machine work is still more indefinite. Apart from such pieces as are necessarily made on that machine, there are many which, in the hands of an expert, can be made more quickly one at a time on it than otherwise; while of others a principle similar to that given for the turret lathe would hold. The broad principle that the more highly organized methods are only applicable to parts made in large numbers, holds for all classes of work. These considerations were early forced home to me in connection with the work of organization this factory.* The requirements of interchangeability were just as severe as here—perhaps even more so—while the volume of business was expected to be moderate, and it was essential that the company should not be swamped by an expensive outfit. These conditions are not only the hardest to meet, but, while less interesting from a spectacular point of view than the equipment of a more highly organized factory, they are, in my opinion, essentially more instructive. Your respect for the simple tools to be shown will be increased when I tell you that in the seven years' history of the business, there has never been a complaint or, so far as can be learned, a case of failure to maintain interchangeability. Misunderstandings have, of course, arisen regarding styles of parts and size numbers. In such a business these are unavoidable, but a case of failure to fit in consequence of a failure to maintain dimensions, has not, to the best of my knowledge and belief, occurred in a single instance, and this is a record which I do not believe can be equalled by any other company in the same business in the world.

The conditions described led me to seek for some guiding principle in the form of a rule which, while not superseding judgment, because it could only be itself based on judgment, should nevertheless serve the purpose of a guiding star, so to speak, and at least lead in the right direction, and the rule which I formulated was this: The estimated saving due to a fixture shall recoup the estimated outlay in making it, in one year's time or less. If the proposed fixture will do this, make it; if not, let it alone. In view of the rate of interest obtainable from investments, it may seem unreasonable to require those appliances to earn a hundred per cent. a year; but it must be remembered that the rule deals only with estimates. Sometimes these things cost more than they are expected to and sometimes they save less; sometimes one finds that he has unwittingly entered upon a long course of expensive experiment, and sometimes a flat failure must be faced. Then, too, one never knows when some troublesome inventor will make some improvement in the product, which will lay an elegant lot of fixtures on the scrap-heap—and these things make good scrap. All these considerations show that conservatism in these matters is the only justifiable state of mind.

There are four leading items which comprise the bulk of manufacturing appliances. These are, drill jigs, turret lathes, milling machines and grinding machines, although in this connection the common lathe and the planer are not to be despised. I am a firm believer in the milling machine, but it is nevertheless true that some classes of work can be done more economically on the planer. This is especially true of pieces in which the distortion of the work under the pressure of the cut is of importance. We formerly milled our valve seats, which, in order to make steam-tight joints without packing, require to be scraped on both surfaces; but experience has shown that the spring of the piece under the pressure of a milling cutter is so much greater than that under a planer tool, that the extra time involved in scraping the milled surface made that the most expensive method of procedure. Later on I shall show you some attachments to common lathes which have brought the cost of production of certain pieces down very close to what could be accomplished by the best turret lathe.

In recent years the grinding machine has come to be a large factor in manufacturing operations, by reason of the fact that it will bring a piece to size much quicker than the lathe, and it is now a common practice on such parts as are adapted to the grinding machine, to rough them out only on the lathe and then finish by grinding.

Drill jigs are often quite elaborate tools, although in our work there is nothing requiring anything but simple jigs. Those, however, illustrate the principles of their construction. There are two kinds—plate and box jigs—of which the latter are to be preferred. The holes are fitted with either fast or loose bushes of hardened steel. The best plan of making the latter is to make them with a slight taper on the outside, the hole in the casting being correspondingly tapered. This method obviates the inaccuracies due to wear in a very large measure, and by it it is only necessary to have one set of bushes, which are used interchangeably on the various jigs as required, and so reduce the cost of the latter to very nearly that of those having unbushed holes, which are sometimes used through mistaken ideas of economy. An essential feature of jigs is the stops by which they not only locate the holes correctly with respect to each other, but also correctly with respect to the casting as a whole. A general principle regarding these stops is, that where they bear upon finished surfaces, they should be fixed, but where they bear upon unfinished surfaces of the rough casting, they should be adjustable in order to provide for the variations to which castings are subject. Another feature of jigs, and of special tools of all kinds, is that of coordination, by which the operation of each tool is made to prepare the way for the one that follows it. Much judgment is required in scheming a set of tools which follow one another in this way, in order that the operations may be performed in the proper order to secure the best results.

The following tools have been selected in order to illustrate what has gone before, but subject, of course, to the condition that the operations of the shop should not be interfered with.

(Lecture completed with exhibition and explanation of a large number of special fixtures and appliances.)

* For the production of rock drills in Canada.

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Pump Center Dividers—Some Drilling Tools.

BY A. H. CLEAVES, CHICAGO, ILL.

What is known in some shops as the Swiss compass or pump center divider is frequently very useful, not only for watchmakers, but machinists in general.

The imported ones that I have seen for sale in the stores are made with a long screw and bar parallel with each other, for carrying the point. They are not very convenient, as the screw must be turned with a small knurled handle to run the point forward and back, using it, perhaps, at the two extreme distances in succession.

Fig. 1 represents a home-made tool of this description, and makes a good one for apprentices to practice on where they are permitted to make something for themselves at favorable intervals, and care to do so.

The handle *A* can be made entirely of steel as shown, or of black rubber and steel together. The bar *B* is round work all through, the sides of the ball shape turning on the same, being flattened or faced off on an arbor at *LL*, where *A* is secured to *B*. And this makes a substantial and neat joint.

The sleeve *C* which covers *B* is flattened on top for set screw to rest on; and has a slot underneath in which the pin *J* slides. *J* is fast in *B* and is flattened on the sides to fit the slot in *C*. The adjusting screw *E* with its collar *F* and handle *G* are component parts of the sliding sleeve *C* as shown; *F* being screwed on to *C*, and *E* pinned to *G*. This sleeve *C* carries the compass-point-holder *H* which can be set immediately to approximate position and then adjusted with *G*. The point *I* can be reversed end for end to get a longer range.

D is the pump-center, so called, and moves up and down as shown in the drawing. To set the points bring them close together and fasten *D* with set-screw *M*. Then move the point *I* on a scale or any measure to be transferred.

In dropping the point or in setting it, even, the bar can be set parallel by the eye, the center *D* being raised or lowered

in the place it is to work in until *C* is level, as seen in the cut. *I* is flattened on the under side for set screw; and *D* on the side next to *M*. *D* should be a good fit in *A*. *K* is merely to show the way distances are taken or placed on surfaces in different planes. *H* is all round work; being round steel turned as shown in the profile, the holes for *C* and *I* being obtained as I have explained in other papers.

It may be well, however, to describe one or two methods of doing this and similar work; drilling the two holes for *C* and *I*, for example, in *H*, Fig. 1.

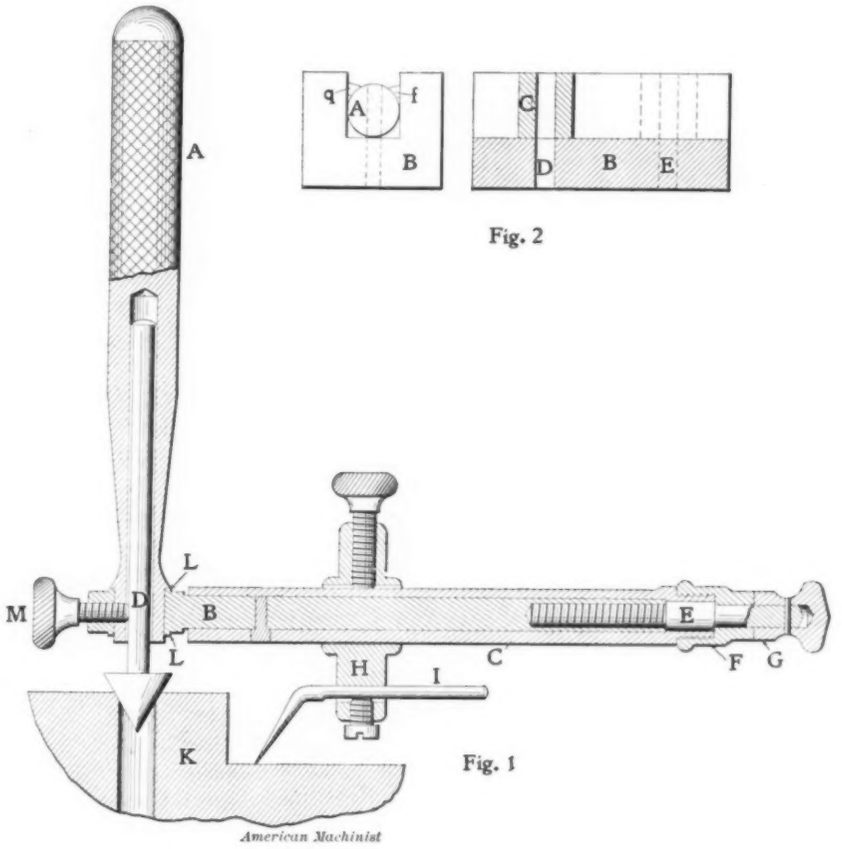

Fig. 1

Fig. 2

PUMP CENTER DIVIDER AND DRILLING FIXTURE.

Drill the two holes first in full size, straight rod, then plug with pins of the same metal either driven in or soldered, after which turn to shape, finish and remove the pins.

For getting the holes in *H* the following may do: In Fig. 2 let *A* in the end view show the piece to be drilled, and *B* a brass block with groove planed in it to receive *A*, fitting closely. Then in the side view let *C* be a bushing with hole in it the size of *I*. Mark on top of the block *B* with a square two lines equal to the distance between centers of holes for *C* and *I*, Fig. 1. Have a line on the side of *C* and locate the holes with this and the two on top of *B*. Let *C* drive or crowd into *B* a little and drill at *D* and *E*. Then place *A* in the groove, and solder liberally at *f* and *g*; drill through from the lower side of *B*, as shown in the drawing, and open the hole for *C*, Fig. 1, with larger drill or counterbore. Heat up the work and wipe the solder from *A*, and turn up the same on centers. The block is made in short order if a shaper or milling machine is at hand.

Figs. 3 to 6 furnish a design for general use in drilling round work like the above. In Fig. 3, *A*, *B* and *C* give an idea of the range of work, according to the size of tool made. Fig. 4 shows plan of Fig. 3. *D* represents a sliding jig fitted to vertical groove *E*. This rests on the round work *A* of any diameter within the limits, and, having an open slot at *D*, can be removed at once from the screw *F* to allow of enlarging hole in *A*, etc.

G, Fig. 3, is one of two clamps shown in Fig. 4 for binding the work. One of them has a slot *H* and hole *I*; *H* being to allow of moving *G* away from *D* when a large hole is to be drilled or opened out. *I* is a hole larger than the hole *J* in *D*, and admits of drilling through the hole *J* by clamping *G* over or on top of *D*, thus tightening *D* onto *A*, and holding the same from revolving. This is needed when a thin collar, etc., is to be drilled, and which will not admit of being clamped outside of *D*, because narrower than the same. *G* has screws *K* and *L*, which admit of ready adjustment in binding the work. *M* is a cast-iron block to rest against lathe face-plate or drill table in drilling.

Fig. 5 shows two things: The block *M*, Fig. 3, has two grooves, a V-shaped one, with a straight one *N* central at the bottom, and running the whole width of *M*. In Fig. 5 the pin *O* is used in a hole already drilled, one end being in *N* to insure drilling the next hole in line with *O*.

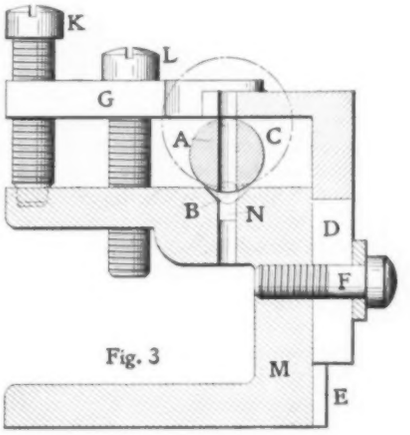

Fig. 3

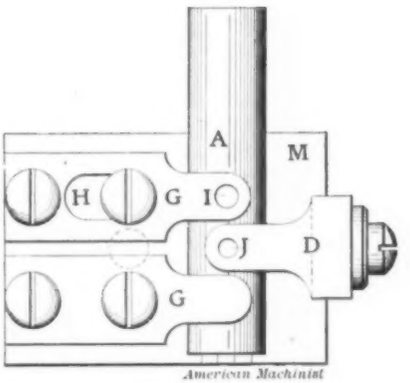

Fig. 4

FIXTURE FOR DRILLING SHAFTS.

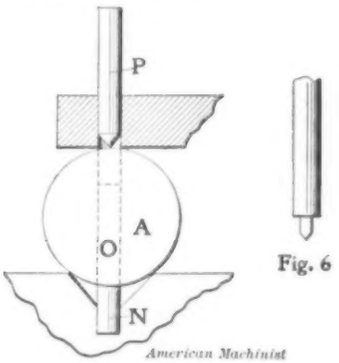

Fig. 5

Fig. 6

DRILLING HOLES THROUGH SHAFTS.

P is a centering or locating pin to enter prick-punch mark or hole in *A*, before clamping to be drilled. Fig. 6 shows a test drill for starting smaller hole than *J*, Fig. 4, in the work.

It is, of course, obvious that these fixtures and methods can as well be used for many other jobs, with little or no alteration, and I have shown them mainly because they are typical examples of methods that can be followed for any similar work, and a good workman can easily secure results by them.

The Construction of Armature Cores—II.

BY WM. BAXTER, JR.

If an armature core is built up of sheet iron segments, instead of complete rings, the arc of the circle covered by such segments, may be anywhere from 180 degrees down to 20, or even less. The larger the armature the greater the number of segments, but the number best suited to each particular diameter, cannot be said to be fixed; it will depend in part upon the manner in which they are held in place, and in part upon the notions of each particular designer. If the construction is such that the labor increases in proportion with the number of segments, it is evident that the larger they are the better. If, however, the labor is not materially increased by increasing the number of segments, then it will be advisable to use as many as possible, that is, so far as the question of construction is concerned. There is another side, however, from which the subject must be considered, and that is, the magnetic effectiveness of the core. If the ring Fig. 1 represents an end view of a grooved ring armature core, it will give the best results, so far as the action of the magnetism is concerned, if the sheet iron is punched out in complete rings, owing to the fact that there will be a continuous metallic path in each ring, therefore, the resistance opposing the magnetic lines of force will be reduced to the lowest point. If the difference between the magnetic resistance of air and iron were small, there would be but a slight objection to breaking the metallic continuity, by the interposition of joints, but as there is a difference of from six hundred to one thousand to one, between iron and air in this respect, the effect of joints will become noticeable unless means are provided to offset it. If the core Fig. 1 were made of four segments of the length *a b*, and were placed in a two pole machine, the magnetic lines of force would have to pass over two joints at all times, except when one pair of joints were in a line parallel with the center line through the pole pieces. If the core were composed of eight segments, of the length *b c*, the number of joints the lines of force would have to traverse would vary from three to four. If the machine were of the four pole type, a four segment core would interpose one joint in the path of the lines of force, and an eight segment ring, two joints. In an eight pole machine, the four segment core would interpose one joint part of the time, and the eight segment core, one joint, practically, all the time.

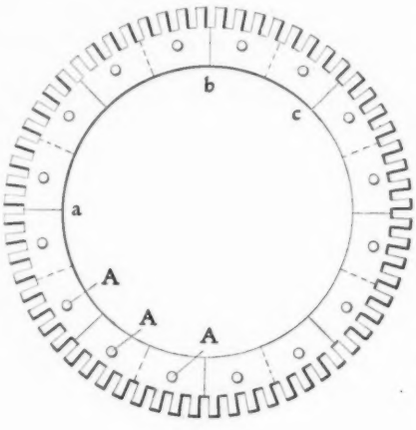

Fig. 1

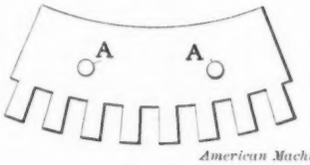

Fig. 2

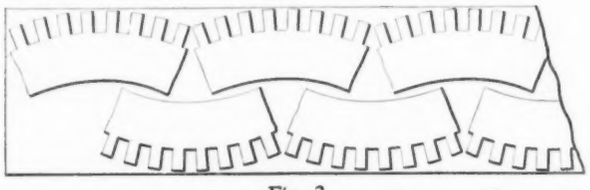

Fig. 3

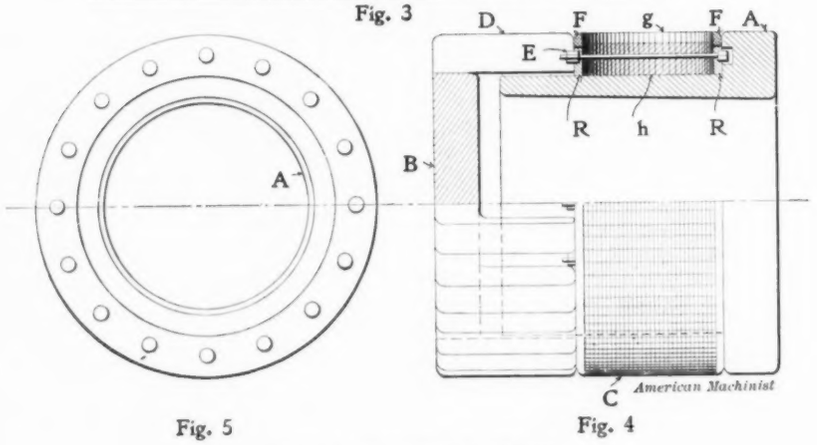

Fig. 5 Fig. 4

MAKING ARMATURE CORES.

These would be the conditions that would prevail if no effort were made to overcome the defect introduced by the joints, but there is a simple way of counteracting the defect, and by resorting to it a core built up of segments can be made so nearly as effective as one made of complete rings that the difference is not worth taking into consideration. As has been stated, in a previous article, the object of making the core of sheet iron is to break the metallic continuity in a line parallel with the shaft, so that there may be no circuit in which electric currents may flow. To break the continuity, the sheets of iron are separated by sheets of paper. If we were to build the core with paper interposed between each layer of iron the magnetic lines of force would be compelled to jump across an air space to pass from one segment to another, but if the paper is inserted between the alternate layers, one set of segments will come into direct contact with another one adjoining it. In this arrangement, there would be two layers of iron segments, then one of paper, then two more of iron, and so on, from one end of the core to the other. The scale on the sheet iron would interpose sufficient electrical resistance to prevent the establishment of an electric current from one layer of segments to the other, and therefore, the construction would not be less effective from an electrical standpoint than if all the segments were separated by paper. The magnetic resistance of the scale upon the sheet iron is not much higher than that of the iron itself, therefore, in passing around a joint in one set of segments, the lines of force could pass over to the adjoining set, and thus avoid the resistance of the air gap between the ends of the segments. The only difference between this arrangement and that of solid rings, from the magnetic standpoint, is that where the joints are located the lines of force would be crowded together more than at other points, the effect of which would be to increase the resistance, but only slightly. Thus it will be seen that by simply leaving out the paper between the alternate layers of segments, the lack of metallic continuity caused by using segments, instead of complete rings, is practically compensated for, as each pair of layers may be considered as a continuous ring whose cross section is reduced one-half at the points where the joints come, and as the length of these regions of reduced section is very small, the effectiveness of the structure is impaired to an extent that is not worthy of serious consideration.

An examination of Fig. 1, which is built up of segments covering one eighth of the circle, will show, clearly, the advantage of leaving out the paper between the alternate layers. As shown by the dotted lines, the segments in one layer

break joints with those in the adjoining one, brick work fashion, hence, each segment in one layer laps onto one in the other layer for one-half of its length, and with such a large surface of contact, the lower magnetic conductivity of the scale on the sheet iron is more than compensated for. It might be suggested that by using iron from which the scale had been removed, the magnetic quality of the core would be improved, and, theoretically, it would, but the gain would be microscopic, and would be less than the electrical loss arising from the fact that then there would be no insulation whatever between each pair of layers, and the core would therefore be no better than if made of iron of double the thickness.

Fig. 2 shows more clearly the form of the segments used in the core Fig. 1. Segments of this length are desirable even for armatures as small as eighteen or twenty inches in diameter, for several reasons. As will be seen from Fig. 3 they can be cut from the sheet with very little loss, much less than if they were quadrants. The die to cut them out can be made at less expense, and thinner, as well as smaller, owing to the fact that it is nearer to a straight line, and, therefore, not so easily sprung. A point of fully as great importance as any is, that when the die wears out it can be duplicated with greater certainty, than one of double the length, since the shrinkage caused by the hardening process can be more accurately provided for. This point is an important one because the dies will wear out in a comparatively short time, and the production of exact duplicates is not as simple a matter as the uninitiated may suppose.

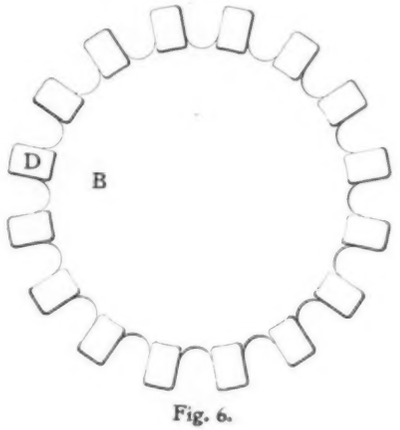

Fig. 6.

The core is built up on an iron core shown in Fig. 4, in elevation, one-half being in section. This frame consists of two parts, the base *A* upon which the core is assembled, and the compressor *B* by means of which the segments are pressed together. A top view of the base *A* is shown in Fig. 5 and a view of the compressor *B*, inverted, is shown in Fig. 6. The compressor has projections *D* which press upon the core between the bolts *E*. These bolts are placed temporarily in the holes shown at *A* in Figs. 1 and 2. In order that the core may be pressed up as tightly as possible it is desirable to use a hydraulic press, but if one is not available, screws will answer the purpose, but they must be of large size, and as many of them as can be used. The compressor *B* should be made of steel, and if the pressure is obtained by means of bolts, they should be arranged to pass through the inside of base *A*, so as to leave an unobstructed space on the outside for the workmen.

As to the pressure required to draw up the core, it may be said that the more the better, but if it is obtained by bolts, there should be at least one square inch of bolt cross section for each ten inches of area of the core ring, this area to include the teeth. The bolts should be not less than one inch and a quarter in diameter, and with square threads. As will be noticed in Figs. 1 and 2, the holes *A* are nearer the bottom of the teeth than the inner diameter, the object of this being to distribute the pressure evenly. If the holes were placed central, and the core were thin with long teeth, the result would be that the inner edge would be pressed up the tightest, and the width of the face *g*, Fig. 4, would be greater than that of *h*. The

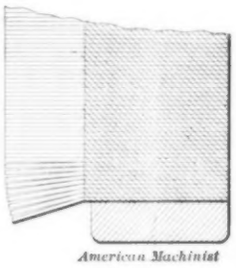

Fig. 7

rings *R R* are made of wrought iron and form the ends of the core, but the rings *F F* are only used while the core is being pressed up, and serve to prevent the teeth from spreading out at the ends as shown in Fig. 7, which would be the result if they were left unsupported.

The bolts *E* should be made of steel well polished, and to fit the holes closely, they should be provided with long nuts so as to not strip the threads. When the core has been pressed up as tight as possible, these bolts should be screwed up until all the slack is taken up, but not as tight as they will go. The compressor *B* is then removed, and the core taken off the form. If the bolts *E* are screwed up too tight they may give away when the pressure of *B* is removed, but this will not occur if they are only tightened up enough to take up the slack.

The form *A* should be as long as necessary to hold the core before it is compressed. The number of layers of segments to give the core the required width should be determined, experimentally, when the first core is built up, and after that the same number should be placed in every core. To guard against any mistake in the thickness of the iron, the core should be pressed up when the proper number of layers have been put in place. If it is found to be all right, it should be slacked up entirely, and the whole surface should be covered with shellac, an effort being made to work it into the joints between the layers of segments. The core should then be immediately pressed up again, and the nuts placed upon the bolts *E*. It should then be removed from the form.

After the core has stood for a day or two, the bolts *E* are removed, one at a time, and the permanent rivets put in their place. These rivets are insulated from the core by a covering of linen secured to the rivet by means of glue. This covering must be put on neatly as well as strong, so that the rivet may fit the holes as tightly as possible. The insulation at the ends is effected as shown in Fig. 8, the rings *a* being made of iron, and the insulation *b* of fiber. The counterbore, as well as the ring *a* should be slightly taper, so that it may be drawn up to a tight fit by the rivet.

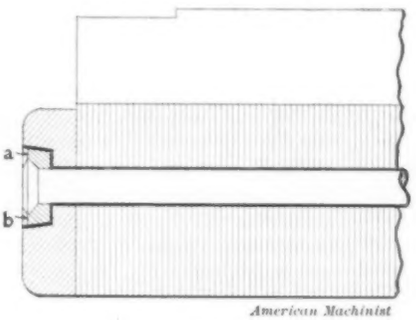

Fig. 8

The more important details in the process of construction, as well as the results of imperfect workmanship will be considered in another article.

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A small fire-brick arch to set over a blacksmith's fire has been devised and put on the market by C. E. Moore, master mechanic of the Chicago City Railway. When the arch is set over the fire it becomes white hot almost immediately, and the heat is reflected back upon the top and all around a piece of iron or steel placed in the fire, heating it more uniformly and quickly than in the open fire. Steel workers and tool dressers, especially, should be able to appreciate the device.

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The Yashima, the new Japanese battleship, built in England, is said now to be the fastest battleship afloat. She made 19.22 knots for four hours and 19.46 knots for one hour. She is 372 feet long, 73 feet beam, 26 feet 3 inches draft, and has 12,400 tons displacement. Her armor ranges from 18 to 14 inches in thickness.

The Place of Our Destination.—VIII.

Editor American Machinist:

OBSERVATIONS IN BRUSSELS.

I could extend the report on the machine tools and engines at the Exposition here to a much greater extent, without saying much of interest or anything of value, and as I expect to have opportunities to see others of more interest, will try and make a better use of my opportunities. Among the finest things shown is, first, the ornamental wrought-iron forgings. A friend of mine who is likely to take poetic license in describing such things, would say, the rose twigs have thorns so sharp you can prick your fingers on them; that you can see the blush on the buds and smell the perfume of the roses—but then he would lie about it, though certainly the work of the artists in this ornamental iron work is simply marvelous, as is also the cut glass, enameled copper, and various others of the art metal work.

The annex to the Exposition, in a park some miles away, is to show off the Congo national characteristics, etc., Congo being a Belgian colony.

An electric railroad, just about in running order, connects the two, and is interesting, being built by the Thomson-Houston people, using Walker dynamos, and engines built by the Phoenix Company, of Ghent. For some reason, which I believe they have found since, it was taking about all two 400 horse-power engines could do to run four or five cars.

This particular case was a pretty good example of left-handed economy, not entirely confined to Belgium.

The engines were compound condensing, built to meet pretty rigid specification as to steam economy, and we noticed eight men in attendance, to say nothing about the men at the boilers. And so it occurred to me that in our electrical engineer's writing of specifications as to steam economy, they had better include the number and wages of the men who are to get it out of the engine.

In talking with the superintendent of one of the large works, he made the remark that they have altogether too many professors in Belgium, specifying steam economy down to one-tenth of a pound, and figuring indicator cards to the fourth or fifth place of decimals, when no two men would either make or measure them alike much within the first place.

There is a lesson to be learned by our people who send machines abroad, from the Belgium experience with the American dynamos—both driving pulleys smashed up in regular service soon after they were started. Think of the effect of the failure of such a simple and well-known element on a machine whose makers no doubt would like foreign trade—and all to save a dollar's worth of cast iron in a machine which cost a thousand or two times that amount. It is one of the many things we have all to learn—that because the thing is all right with us, it ought and of necessity must be all right abroad. We do not all get everything right at home, and sometimes fancy it will do to send the poorest we have to some foreign country where they will not know the difference.

In this connection a case has just come up. A machine was ordered from a New England Company who aspire to turn out good tools. When the machine arrived it was found very light, and so out of true that one part had to be packed out with shims to get it anywhere near square.

The purchasers considered the machine so low priced that the builders could not afford to do any better, and so concluded not to say anything about it.

There is no question in my mind that the machine was shipped without being tested, the builders trusting to the truth of their machines or men for the accuracy of the different parts coming together square; neither of which can always be depended upon. The grinding machine is about the only machine that leaves a piece true—and that not always.

The only shop I was able to visit in Brussels was that of Mr. Bollinckx, which I understand Mr. Miller also visited and no doubt described, so I will only remark about his product, the Corliss and Bollinckx engines. His method of putting together the two halves of the Corliss engine cylinder, as shown in the "American Machinist" a year or two ago, seems to me the best of the steam jacketed type. There is no uncertainty about cored jackets; and, compared to the bushed variety, his bushes cannot come loose. It enables him to corrugate the outside of the bush, and he gets his exhaust valves up part way into his cylinder and so reduces clearance materially. His new engine, cuts of the cylinder and valves of which you also published later, is certainly a nice looking machine, and if, as we all believe, economy is gained by small clearance, and more particularly by small clearance surface, this engine ought to be the best design ever brought out, at least to my knowledge. He not only gets rid of much clearance and reduces the clearance surface below others, but his exhaust valve drops out the entrained water, as well as the original Corliss. There is the one great drawback for American practice—the inconvenience in getting at the piston; but in his case it counts less against him, because other builders of Corliss engines put their valves in the heads as well, and to which the same objection exists.

Some objection has been raised to his method of constructing cylinders, because it does not give the opportunity for using hard iron. To this there may be two replies: First, why not have the whole casting of a Corliss cylinder hard, for if the cylinder has need to be hard, then the valve seats need to be hard also. But, second, does any one know for certain that a hard cylinder is any better? I know Mr. Corliss made certain engine cylinders very soft and they were as smooth as a bottle and have run for years without trouble.

I found many things of interest in the works—the pit planing machine about which I shall have something to say later in connection with other works; but for the reason first given, will defer mentioning, much less attempt a description of the various interesting things.

Brussels is a beautiful city, and owes its beauty in a large measure to the good sense and public spirit of its citizens, or a ruling king who rules in the interest of the people.

One good thing comes of a fortified city, or at least has come to Paris and Brussels, and that is when by expansion it has become necessary to tear down the fortification it has left the boulevard. Brussels is now about three times as large as the original walled city, and this boulevard forms a broad street around between the center and the outside from two to three hundred feet wide. It is more than a street or avenue, it is a street and a park. It goes by different names at different parts, and Boulevard Waterloo—the widest—is first a sidewalk, then a paved street, perhaps fifteen feet wide, for business purposes, then ground with two rows of trees, thirty feet wide for horseback riding, then forty feet or so of asphalt or macadam for carriages, then eighty feet (at a guess) with four rows of trees for pedestrians, with seats for resting, then another paved street for business and street cars, and lastly the other sidewalk. At different places booths for selling papers, etc., waiting rooms for the street car service and public conveniences. Through the town there are two broad avenues, and many outside like the Avenue Louise, which leads out to the Bois, and, like the boulevard, has the same combination—part street and part park of itself—the other streets are neither wide nor straight, but cool in a hot day and likely warm in winter.

The buildings are not whole blocks from street to street as in Paris, each separate house or store varying somewhat one from the other, but they are all in a locality or block about of the same hight and degree of finish—all kept clean and bright—the telegraph and telephone wires all over the tops strung from roof to roof and the whole city supplied with street car service. One of the lines is supplied with cars that run on the track where there is a track and turn out on the pavement where there is none. This is done by using common omnibus wheels for the carriage and two leading wheels which drop into the grooves in the rails—when in line—which keeps the car on all right. By custom, law or common sense none of the carriages have tires less than

about two inches wide, so that the ground rail does not interfere at all with the common street traffic. The King, either by his power or influence, sees to it that the companies give the worth of the money. The fares are very low—only a cent for short rides—varying acording to the distance—and the companies are no doubt managed on economical lines; as an example, the tickets or receipts are printed on paper and are cancelled by the conductor tearing off the corner. How simple compared with the thick ticket and punch. The street cars or tram cars have maps of the route over which they travel posted so one who can follow a map can see where the special line he is on goes, what main streets it crosses and where it connects with other lines.

Probably nothing has been said about Brussels for the last three hundred years that did not include the "Hotel de Ville" or Town Hall with its open work spire. Inside it is a museum with many curiosities and noted paintings. Surrounding it and throughout the old part of the town there are many ancient Flemish buildings, and in the new part the "Hall of Justice," one of the largest, if not the very largest, building in the world. It is larger than St. Peter's; and though Philadelphia claims to have the largest, this is 500 x 600 and 400 feet high, as against the Philadelphia 460 feet square by the same hight; and the Philadelphia building has a large open court, which the Brussels Hall of Justice has not. Anyway, there is an awful lot of stone and architecture about it.

I do not know whether they deal out justice on the same scale as the building, but the affairs of the city seem to be well managed; and one would think, from the talk of the people, that the king has a good deal to do with it. He is greatly liked; is around the streets and in the exhibition every day, and stops to talk to the exhibitors and workmen. We had the honor of meeting him two or three times; he was going one way in the aisles of the exhibition and in the street, and we were going the other. "Long live the king!"

JOHN E. SWEET.

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Patternmaker's Face-Plate Lathe.

We illustrate herewith a new design of a patternmaker's face-plate lathe which has recently been put on the market by Fay & Scott, of Dexter, Me.

The illustration is almost self-explanatory, and from it it will be seen that the work is surrounded by a framework composed of 2-inch iron which is so arranged as to be adjustable in all directions, both to bring the rest into proper position for the work, and also to provide for turning at an angle, for which purpose the clamping flanges which connect the bars of the frame are graduated to degrees. Both plain hand rests and a compound rest are furnished with the machine, either of which may be mounted for turning the face or edge of the work. The countershaft is arranged to run at two speeds, giving a range of eight speeds from that suitable for the full swing of the machine —84 inches—down to the smallest likely to be required.

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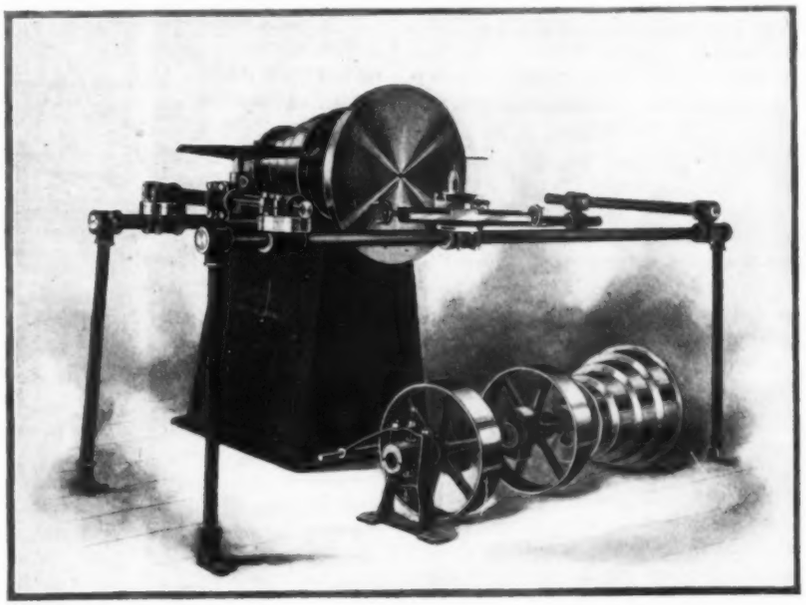
Hardening Copper.

A patent has recently been issued for a process for hardening copper. We are unable to say what the effects of the process may be, but a description of it is as follows:

In carrying out the method enough finely-powdered clay is mixed with clear vinegar to make a pulpy mass which is to be stiff enough so that it may be readily worked. The copper to be hardened is



PATTERNMAKER'S FACE-PLATE LATHE.

then covered with the moistened clay set forth, which is either in the form of a ball or other shape, and the said clay, with the copper therein, is placed within a furnace directly on the fire thereof and allowed to remain from five to six hours under intense heat. At the expiration of this time the clay carrying the copper is removed from the furnace and quickly submerged in cold water. The clay is then broken open and the copper removed and the same operation repeated successively until the copper has reached the desired degree of hardness. When the clay is broken open after being heated, the copper will be found to be surrounded by a thin crust which readily peels off, leaving an interior portion of the copper whiter than the said crust, the latter being red. The successive hardening operation set forth on each piece of copper will gradually lighten its color, and the crust which forms on the copper is apparently one of the several constitutents of ordinary copper exuding and depositing on the outer surface.

By a qualitative and quantitative analysis of a given quantity of the clay used in the method the constituents and their proportions are found to be about as follows: Aluminum silicate, five parts; silicate, ten parts; iron sulphate, one part; sodium, trace; potash sulphite, trace; earthy residuum forming balance.

The patentee is Jakob Reuter, Fullerton, Kas.

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Mr. J. H. Carpenter, of Reading, Pa., founder of the Carpenter Steel Works and formerly its general manager, has prepared a statement showing that steel armor plate can be furnished to the government at figures far below those now paid. He gives detailed estimates, which apparently show that by the new process the cost at the mill need not exceed $100 per ton. He proposes to organize a company and build a mill which will show a good profit in furnishing the plates at one-half the price allowed by law, or at $150 per ton. Mr. Carpenter's proposition seems to come quite opportunely. A board of officers, appointed for the purpose, is now engaged in examining the armor plate, and it has arranged to inspect Mr. Carpenter's works also. If Mr. Carpenter is correct a new era in heavy steel working will be inaugurated, and the cost of other things than battleships may be lowered.

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On a recent afternoon some enterprising individuals in New York cut down and carried off 2,500 feet of electric wire, through which a current of 2,500 volts was passing, and detectives are looking for the men. This is at least the third time that this trick has been done.

The Locomotive Link Motion.—I.

BY F. A. HALSEY.

APPLICABILITY OF THE LINK MOTION TO LOCOMOTIVE CONDITIONS.

Probably no conspicuously successful mechanical device has ever been assailed so persistently as the locomotive link motion. The steam distribution which it gives is so unlike what is considered best in stationary practice, and so like what is considered bad in that practice, that many engineers have regarded it almost with contempt as a device whose only redeeming virtue lay in the fact that it kept going. It is altogether probable, however, that these opinions are mistaken ones and that the link motion comes little short of being all that can be desired for a locomotive valve motion. The locomotive works under conditions peculiar to itself; it must in consequence be studied by itself, and conclusions based upon experience with stationary engines have little or no applicability to it. It will be shown that the action of the link motion on the movement of the valve and the distribution of the steam, is essentially the same as that of the shifting eccentric, with, however, a still more restricted port opening, except in cases where the Allen valve is used, and it is to the restricted port opening, the early release and the heavy compression that the criticisms have been directed. In replying to these criticisms, the advocates of the link motion point to the well-known fact that an extreme degree of expansion in one cylinder is not conducive to economy, but the reverse, and they claim that the mean effective pressure required by a passenger locomotive at speed is so small, that if it were to be obtained by a steam distribution analogous to that given by the Corliss gear, the cut-off would be so early as to have passed the economical point, and that under such conditions, partial throttling, with its consequent superheating, is better than cut-off without throttling. The heavy compression, so far from being a defect, considered purely as a feature of the steam distribution is pointed out to be here a positive advantage, as its effect is to reduce the cylinder capacity and thereby introduce a later cut-off than would otherwise be required. Moreover, apart from such considerations, the easy cushion due to a long compression is considered a mechanical necessity, to quietly absorb the momentum of the parts at speed, while the early release due to notching up the link is exactly adapted to the conditions, inasmuch as, when starting with the link in full gear, the speed is slow and the release is late, as it should be, while at speed, when increased exhaust lead is required to compensate for the increased speed and provide sufficient time to enable the steam to escape, it is provided by the drawing of the link toward the mid gear which accompanies increase of speed.

In freight engines the mean effective pressure is greater and the cut-off later than in passenger locomotives. The port opening is consequently larger and the compression less, so that there is little to criticise in these respects from the standpoint of the critics of the link motion, who have in fact mainly directed their criticisms to passenger locomotives. The cylinder problem of a locomotive is in fact entirely different from that of a stationary engine. With the latter, the problem is to determine the size of the cylinder and the distribution of the steam to drive economically a given load at a given speed. With locomotives, the cylinder is made of a size which will start the heaviest train which the adhesion of the locomotive will permit, and the problem is then to utilize that cylinder to the best advantage at a greatly increased speed, but under a greatly reduced mean effective pressure.

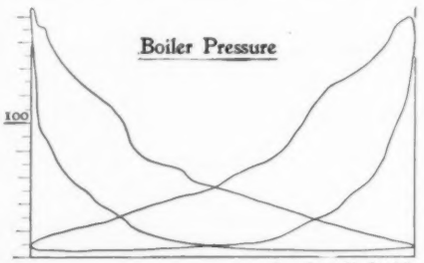


Fig. 1

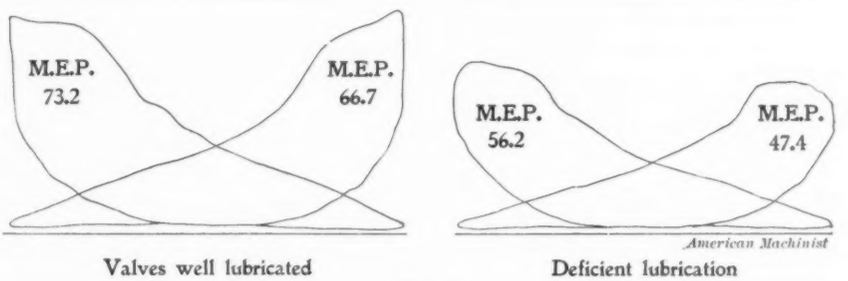
It will thus be seen that the properties of the link motion are fairly in the direction of the requirements, and while notching up the link may not give the changes desired to the exact degree which refined considerations might dictate, it does give them in the right direction and probably as nearly correctly in degree as the varied conditions would permit even with the most elaborate valve gear.

The difficulty of the restricted port opening has no doubt been unduly magnified. There can be no doubt that many cases of loss of pressure in the cylinders of stationary engines have been attributed to the small port opening which belonged to the long steam pipes, for it is an undoubted fact that a mere diaphragm in a steam passage, which is what the port opening amounts to, does not give the obstruction to the flow of steam that would be expected from its area. Moreover, the common rules for port opening are based on experiments with engines having a late cut-off, and there can be no doubt that with an early cut-off and the accompanying comparatively low velocity of piston up to the point of cut-off, the port area required is not as large as when the cut-off is late. The indicator cards given in Fig. 1* show clearly enough that the loss in pressure at admission is much less than would be expected from the small port area and certainly show little need of a new valve gear to reduce it. Some may object that these cards are better than the average and so are not fairly representative of the work of the link motion. Be this as it may, they show what it can be made to do. Many, whose opinions are entitled to every respect, would say that they show too little throttling for the best economy. There can be no doubt that many cases of low steam line in locomotives are due to defective mechanical features of the valve gear and not to its geometrical properties. Fig. 2† gives indicator cards which show the effects of spring in the crooked eccentric rods which are often used on consolidation and 10-wheel engines. The engine from which these cards were taken had such rods, and the differences shown between the two pairs of cards were brought about by changing the lubrication of the valve —the spring of the rods being largely removed when the oil supply was sufficient.

THE STATIONARY AND SHIFTING LINK MOTIONS COMPARED.

It will be shown that the shifting link motion gives a varying lead for different rates of expansion. This has been considered by many to be a serious defect of this gear, and some gears have been devised largely for the express purpose of overcoming it. It is, however, probable that this supposed defect of the shifting link, like those of link motions generally, is, as a matter of fact, a point of superiority.

The variable speed under which locomotives operate must always be kept in



Valves well lubricated — Deficient lubrication

Fig. 2

* By C. H. Quereau, Gen'l Foreman Motive Power, Burlington & Missouri River R. R., in Nebraska, in Proceedings Western Railway Club, March, '97.

† By C. M. Herr, Asst.-Supt. Motive Power, Chicago & Northwestern Ry., in Proceedings Western Railway Club March, '97.

mind in considering any feature of their steam distribution. It is certainly proper to provide a heavier cushion for high speed than for low. This all link motions do, to a certain extent, by increasing the compression. In addition to this, the shifting link gives a further increase of cushion by the increase of lead. It is at least as probable that this increased lead cushion is needed as it is that it is not, while the further fact that the increased lead gives so much increased port opening at short cut-off, is certainly in favor of the shifting link, unless that link gives a larger port opening than is needed, and this its warmest advocates will scarcely claim. It is certainly difficult to see wherein an increase of lead with an increase of speed can be justly criticised.

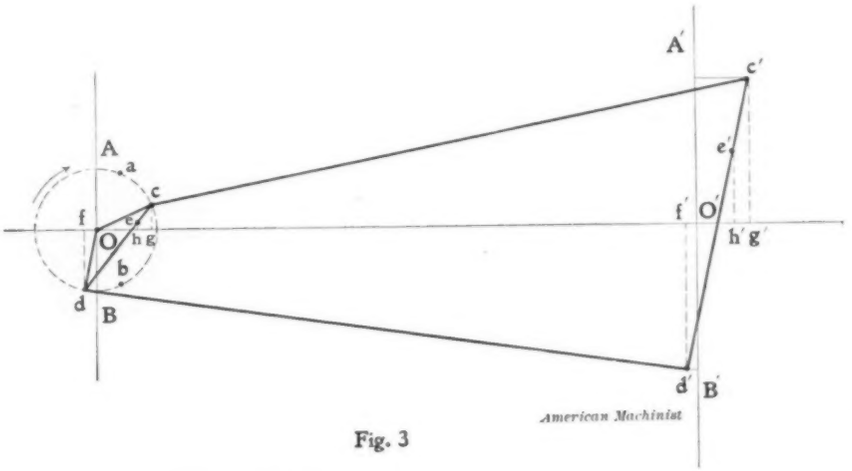


Fig. 3

COMPARISON OF LINK WITH SINGLE SHIFTING ECCENTRIC.

THE LINK MOTION AND THE SHIFTING ECCENTRIC COMPARED.

The movement of a link driven by two eccentrics and hung in the usual manner is extraordinarily complex. These complexities arise from distortions of the motion which are introduced by the angular vibration of the eccentric rods and of the link itself, and by the rise and fall of the link due to its suspending stud being guided in the arc of a circle. While these distortions are present, they are small in magnitude and of little real importance; and by ignoring them the subject may be simplified and the movement studied with a degree of accuracy sufficient for all purposes.

The effect upon the valve movement due to raising the link from the full gear position is essentially the same as that due to shifting a single eccentric across the shaft in the manner common to high-speed shaft-governor stationary engines, with the addition that by raising the link beyond the mid position the engine is reversed, while in shifting eccentric stationary engines, there being no occasion for reversal, the eccentric is not moved beyond the mid position. Were a shifting eccentric arranged to pass the mid position, such movement of the eccentric would reverse the engine and produce all the other effects of the link, and, in point of fact, locomotives have been fitted with such a valve gear.

The first step in the study of the link motion is then properly a demonstration of the similarity of its movements with those of a single shifting eccentric.

This may be done by the aid of Fig. 3, in which, it is to be distinctly understood, the distortions already mentioned are ignored. Consequently the demonstration is only approximate, but it is sufficiently accurate for the purpose; in other words, the movements are not exactly as the demonstration would indicate though they are very nearly so. The dotted circle gives the path of the eccentrics, the position of the forward eccentric for the dead point position of the crank being at *a*, while that for the backward eccentric is at *b*. The shaft is supposed to be turned forward until the forward eccentric has reached the point *c* and the backing eccentric the point *d*; the corresponding position of the link, which is here represented by a straight line, being $c'\ d'$. The line $A'\ B'$ represents the position which the link would occupy if the centers of the eccentrics were both placed at the center of the shaft at *O*. This line is often called the neutral position of the link, although, in point of fact, the link, as a whole, never occupies it. With the eccentrics at *a b*, the link would occupy a position parallel to this line $A'\ B'$, and every point of the link oscillates equally each side of this line, but only one point of the link is on the line at the same time, as the link always crosses it at an angle. The horizontal movements of the points c' and d' are assumed to be exactly the same as those of the eccentric centers *c* and *d*. That is to say, it is assumed that a point dropped vertically from c' to the center line will travel upon that line exactly as will a corresponding point dropped from *c*, and that a point raised from d' will travel as will one from *d*. It is in this assumption that the slight inaccuracy of the demonstration lies, the error of the assumption growing out of the angular inclination of the eccentric rods; but, as before stated, the error is slight and of small importance. Selecting a point as e' upon the link such that, say, $c'\ e' = \frac{c'\ d'}{4}$ and a corresponding point *e* such that $c\ e = \frac{c\ d}{4}$, it is required to show that the horizontal movement of e' is the same as that of *e*; or, in other words, that e' might be connected to *e* by a rod without changing the motion. It is obvious that

$$O\ g = O'\ g',$$

and similarly that

$$O\ f = O'\ f'.$$

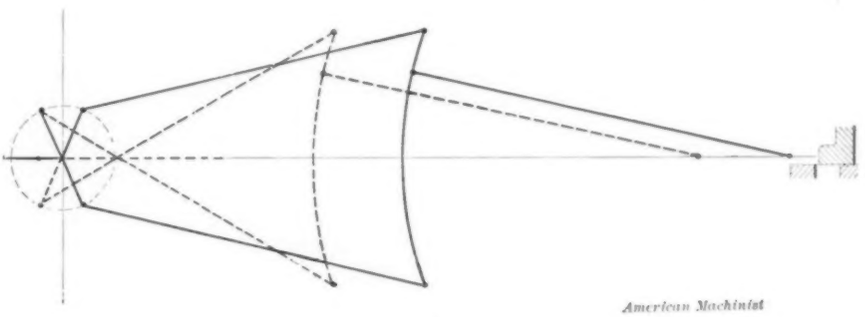


Fig. 4

STATIONARY LINK WITH RADIUS BAR.

The division of the line $c'\ d'$ by e' is in the same proportion as the division of $c\ d$ by *e*, consequently h' divides $f'\ g'$ in the same proportion that *h* divides $f\ g$; that is,

$$f\ h = f'\ h',$$

subtracting $O\ f$ from $f\ h$ and its equal $O'\ f'$ from $f'\ h'$, gives us

$$O\ h = O'\ h'.$$

That is to say, the horizontal distance of e' from the central line $A'\ B'$ is the same as that of *e* from $A\ B$. The same proof will hold for any angle of turning of the crank, and for any position of *e* and e', or, as the ancient geometers would say, *Q E D.*

THE STATIONARY LINK GIVES CONSTANT LEAD.

The above discussion relates strictly to the stationary or Gooch link in which the point of suspension is not changed in

notching up, that being affected by the movement of a radius bar connected with the valve stem as shown in Fig. 4, which shows the same construction as Fig. 3, except that the link is curved convex toward the shaft, and a radius bar of a length equal to the radius of the link is added. The crank is shown in the two dead-point positions, one being given by a full line, and the other by a dotted line; the corresponding positions of the other parts being shown by similar lines. The valve is shown open to its lead for the full-line position, and it is obvious that the radius bar may be swung through the entire arc of the link without disturbing the lead; and the same would obviously be true of the dotted-line position. The feature of a constant lead is characteristic of the Gooch link, wherein it is similar to a shifting eccentric moved across the shaft in the straight line *C D* of Fig. 3.*

(*Continued next week.*)

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Letters from Practical Men.

A California Experience—Making Tools First.

Editor American Machinist:

Reading your editorial of August 12th, entitled "Tools With Machines," brought to mind some experience of mine. Before I found an opportunity to serve an apprenticeship in a full fledged jobbing shop I put in some time pulling the lever on a turret lathe, making gas burners and oil cups. Years later, when I was out of my time (1884), I went to San Francisco into a very lively new shop. The tools were one planer, one shaper, two drill presses, five engine lathes, one turret lathe. The young man who ran the turret lathe came of good stock (his father was a machinist). He was a nice sociable fellow, and he told me he was the only man in the shop who could run the turret lathe. His full set of tools were three boring tools, all very much alike, and a 60-degree center. Most of his work was boring collars for shafting. Later on he was changed to an engine lathe and I had a job to make 50 small hand force-pumps on the turret lathe. I decided to make the piece with most work on it first; so I got my friend, the blacksmith, good natured and went at making the tools. The foreman soon began to follow me around the shop and ask: "Let's see what you are working on now? Why don't you finish those pumps?"

I kept him good natured as best I could, and at the end of 20 hours I had the tools finished and tested, oiled the lathe, looked at the clock and started in—gas burner gait. In 50 minutes I had the 50 pieces done. A few of my shop friends came around to take a look, the superintendent among them. One English friend of large experience told me I was doing the best he had ever seen done, but I would surely get kicked for it. It was the same with the other parts of the pump, each part requiring different tools. One set I made and tested in three hours. To the fifteen men in the shop this kind of work was new to all except myself. But they had something that was new to me. It was a hub bored 3½ inches in diameter, 14 inches long and with ⅞-inch keyway clear through it, cut with a cold chisel, making a good looking job. I got so I could do it in about 60 minutes. Since then I have cut keyways on the miller, planer, shaper, slotter and keyway cutter, but more with the chisel.

O. W. DENOVEN.

▲ ▲ ▲

Where the Pacemaker is Needed.

Editor American Machinist:

Speaking of the mechanical pace-maker, I have lately struck one place where he might do a lot of good. I don't know who invented the summer vacation for the hard-worked machinist, but it is one of the neatest inventions of the age, as I can personally testify. I recently had to take my share of it, and I started out on a more or less aimless ramble, with reasonably satisfactory results. Most of my experiences would not concern the readers of this paper, but I may at least tell them of the place where the pace-maker ought to go. I need not indicate the location, and it is best that I should not.

Well, in the course of my rambles I strayed one day into a large shop where they build steam engines, very good, up-to-date engines that go out in competition with the best engines that are made for electric stations and other service. The engines are good enough; but how they can be built at a profit is more than I can understand. Neither the proprietors nor the men can be getting the pay that they ought to get. The ways of doing work, and especially the rate of doing it, were certainly no better than I was familiar with more than a generation ago, and we all know that machine-shop practice has made great strides in these latter days.

I spent probably not more than a quarter of an hour in walking through the shop, and I saw several things in that time. I saw a man cutting set-screws on an engine lathe. They were about 6 inches long and 1¼ inches in diameter, and he was using the backing belt to run the tool all the way back, instead of throwing out the nut, as some of us fellows were doing before the war. The screws were horribly rough, and I had to ask if they were finished before I could believe it. He said they were only for set-screws, and the boss would not approve of his putting too much time or pains on them. Then I saw a planer working on some slides about 3 feet long. It was traveling about 4 inches beyond the cut in front, and about 18 inches too far back. The back dog had slipped, but the man standing by had not noticed it, until I called his attention to it. This man was apparently running two planers. What shall it profit an employer to have a man run two planers, and do a quarter of a day's work on each.

At the other end of the shop a man was turning the rim of a fly-wheel about 5 feet diameter and a foot or more face, with the rim about 4 inches thick. The entire rim had been roughed off, and a side tool was just started to finish one edge, with a feed of fifty to the inch. I am not mistaken about this. There was a forty-tooth ratchet wheel on the feed screw, which was not coarser than five to the inch, and the lever took two teeth twice to the revolution of the wheel. On this same trip I was in another shop, the direct competitor of this one, where their wheels all showed a finishing cut of a half an inch, or coarser, and yet were in no way inferior in truth or fineness of surface. In the latter shop of which I speak, I saw some very good planed surfaces which showed a finishing cut of not less than 1½-inch feed. The same man who was turning off the fly-wheel rim with the micrometer feed was also running a horizontal boring mill, on which was another fly-wheel set away out of the center, so that the boss for the governor lever could be bored. The hole was about 2½ inches diameter, and it looked ridiculous to see that big wheel waltzing around just for that little hole.

The shop was not a small shop, and its exclusive work is the building of steam engines, and yet I could find in it but one poor little old-fashioned shaper, and no slotter. There were two or three milling machines that might have done pretty well if they could get a chance to. Everything through the shop seemed to be going at the same gait. I might easily have gathered more instances of the pace if I had cared to. This shop certainly needed the pace-maker more than anything else. I do not think they needed much instruction as to what good work is, but they certainly ought to know what a lot of good work some other fellows are doing. Neither proprietors nor men can find any fault with me for calling attention to these things, because I am profoundly impressed with the fact that there is no prosperity to be attained by slow methods. I may call attention to the simple fact that, while work was evidently slack in the shop of which I have spoken, the coarse-feed shop, at the time of my visit, was overcrowded with work all through, and is actually, in these days, running every day twenty-two hours out of the twenty-four.

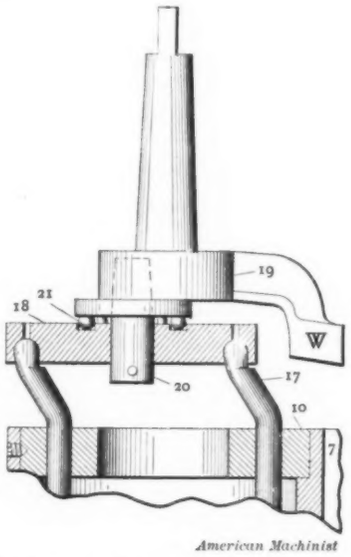
TECUMSEH SWIFT.

*In view of its slight use in this country, an examination of the action of the Gooch link, due to the fact of the paths of its two ends not passing through the center of the shaft, by which the virtual eccentric centers are not the same as the actual, seems uncalled for.

Multiple Drilling Attachment.

Editor American Machinist:

Your illustration and description of multiple drilling attachment in issue of 5th inst. very closely resembles one that was made early in the year 1890 at No. 4 South St. Clair street, Toledo, O., and used for some time at the Bonner brush factory in Toledo to bore holes about one-quarter inch diameter for bristles in a cheap round paint brush. In the Toledo



MULTIPLE DRILLING ATTACHMENT.

attachment about seventeen drills were used and the drill and spindles were all one. The small drill cranks occupied all of the under side of pressure plate so that the larger driving crank was formed integral with the pressure plate and extended upward into a hole in the driving shank.

In using this attachment at the proper speed for drilling soft wood it was found to shake things up pretty thoroughly on account of the pressure plate being out of balance. However, a counter-balance put on as shown at *H'* overcomes this objection.

I think it doubtful if Mr. Warner is the first inventor, although he is no doubt one inventor of the device.

JOHN D. RIGGS.

Chicago, Ill.

[From other contributors we have communications giving time and place in which similar machines have been made for years past, and the device is an old one in the brush factories so far as the bent crank work is concerned. Its special arrangement and adaptation to hub drilling is the new feature.—Ed.]

▲ ▲ ▲

A Cross-Head Key as a Wrecker—A Job of Shrinking.

Editor American Machinist:

I had an experience with a steam engine some years ago that may interest some of your readers, and may be a hint that will save the wrecking of somebody's engine.

It was while I was working for DeGuy, and the circumstances were as follows: There was a 150 horse-power Hyphen-Corliss engine driving the machinery of a flouring mill. The engine was said to be overworked, but I cannot say whether that was true or not, but anyway, the engineer had a great deal of trouble keeping the engine in order. One serious difficulty was that the piston rod could not be kept right in the cross-head, and in a short time, the key had been driven clear up and then DeGuy had fitted a new one, and in a week's time that had been driven clear home.

He made the foregoing explanation, as a preliminary to the information, that I must make a new key—a third one, mind you—for this engine, the next day—Sunday. I told him that there was certainly something wrong, and that I believed something besides a new key was wanted, that I believed that if the cross-head was not already cracked, it soon would be, and there might be serious trouble. The cross-head and piston were brought to the shop, and while there was not the slightest sign of a crack any place, the piston rod had actually been driven into the head from three-sixteenths to a quarter of an inch. We had a band made of 1¼ x 1¼ inch Swedish iron and bored it out, allowing a sixty-fourth for shrinkage, and shrunk it on to the hub, whose diameter was about six inches. As a result of this it was necessary to do quite a good deal of fitting, as when we tried the rod in the hole, it bore only at the outer end. We used the same key, and

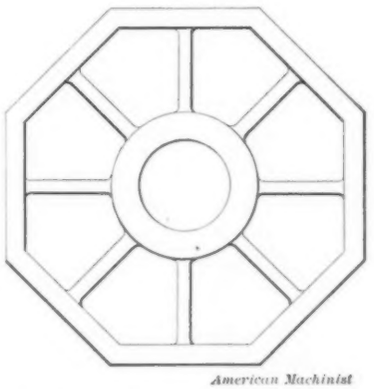


TABLE OF GLASS GRINDING MACHINE.

understood that they had no more difficulty on that score.

Speaking of shrinking the band on, makes me think of a shock that made my gills turn white, not so very long ago. I had charge of the building of some plate glass grinders. The tables of these machines consist of a vertical cast iron shaft, on the top of which is a disk from twelve to twenty-six feet in diameter. The shaft, of course, turns in suitable bearings. In this case, the shaft was twelve feet long and about fourteen inches in diameter, weighing about two tons. On the top end with a bearing twenty-six inches long, was shrunk the head which was an eight-sided concern, weighing two and a half tons, and probably three and a half feet in diameter. To this, radial arms were bolted, and the whole covered with half-inch tank steel. A plan of the head shows more clearly its construction. Considerable difficulty had been experienced at times, owing to the cracking of the heads in heating. In this instance, we placed the head bottom side up over a large salamander and started a small coke fire, which was gradually increased, about twenty-four hours being consumed in the heating. I believe that we were longer than that once. When the gage sticks showed there was plenty of room, the shaft was lowered down into the head, and the salamander removed. A hose with a nozzle made from a piece of two-inch pipe four feet long, with a reducing elbow and a nipple, kept a stream of water playing on the inside of the shaft. I neglected to say the shaft was hollow, though closed at what in its present position is its top end. Burlaps were also wrapped around it above the head, and kept saturated with water. The operation had passed a little beyond this stage, when there was a report like a pistol shot, and naturally the first thought was that the casting had cracked. While we were making an anxious investigation, there was another report, but I got over my scare right there, for it was only a steam explosion. Water would run under the collar on the shaft and then would come the explosion of steam, lifting the shaft about a sixteenth of an inch, and, of course, letting it drop again.

It has been customary to allow a sixty-fourth of an inch for shrinkage on these, and right here I wish to make a point. The bearing for about an inch, right close to the collar, should be a little "heavy" with the calipers so that as the head cools it will grip there first, and if this is carefully attended to there will be no danger of the head drawing away from it, but should the head grip at the other end, there may be a sixteenth of an inch opening. Hundreds of these have been made, and the process has been substantially as here stated. So far as I know, there never has been any difficulty about their getting loose.

Harvey, Ill.

A. L. BOWEN.

▲ ▲ ▲

"Good Enough."

Editor American Machinist:

The "Good Enough" question is one that suggests lots of trouble in the machine shop, and I don't know whether your editorial with that title will do any good or not. Good enough works both ways, and I have had it kick me both before and behind. As a foreman in the

shop I have from actual experience had to learn to detest good enough as a continual double acting source of trouble. As a foreman I, of course, have had to spot over and over again the good enough boy, or oftener the good enough man, whose only standard of workmanship would be to get his work to just pass, both in quantity and in quality, who would never do any more or any better work than just enough of either to save himself from getting bounced. Boys, I am happy to say, are all right if you can only get them interested, and if they can know for sure that what they do is appreciated. A foreman will find the faculty of appreciation to be quite a valuable possession, especially in handling boys. Of course there are some boys that have no mechanical instincts, and in whom no mechanical interest can be awakened. It is cruelty to animals to keep such fellows in the shop, and the sooner they are put to studying law or measuring dress goods, or some harmless occupation of that kind, the better it will be for all concerned. But the majority of boys are more or less mechanical, and there is no trouble about getting them to do good enough average machine shop work, if they find it worth while. For some men in the shop there seems to be no possibility of entertaining any such hopes. All their active interests seem to be outside the shop. They are looking for quitting time as soon as the engine starts. It is too much trouble for them to keep tools in order, or to have any tool ready before it is wanted, to make any effort at precision in any particular, or to look a minute ahead, or to plan beyond what they are doing at the minute. The only consolation when you are troubled with this sort of fellows is that however they may make the work last, they don't themselves last forever. There are others of a different make-up, who in the long run surely crowd them out. The survival of the fittest, in the long run, works with success in the shop.

The fellows of the kind I have been speaking of, who run by the good enough standard, are only one kind of trouble that the foreman has. They all the time want to shove onto him what is not good enough for good enough, and it never works to the satisfaction of anybody. But there is another and a very different, and almost as bad, a good enough trouble that you sometimes have to encounter, and it may be with the most conscientious and faithful man in the shop. They are the fellows who insist on a monotonous uniformity of pretty good, and generally good enough, work. Now, work may have very various requirements, but you never can get them to see it. All that they do must be of the same quality and jog along at the same rate. No matter how rough may be the requirements, or how urgent the haste, everything must be done with the same deliberate precision and the same painstaking accuracy. They insist constantly upon their standard of good enough and they can never be made to accept yours. Their standard is never too high for the best of the work, but the work is not all best, and yet the constant good enough level is maintained through it all. The high level good enough, if not altogether as bad as the low level good enough, is sometimes quite as exasperating. And the worst of it is that it is so expensive. As you rightly say, good enough work has to be good enough in cost as well as in everything else, but that element of good enough does not come into the calculations of these fellows.

I believe that pattern-makers are the worst offenders in this line, and in proportion to the amount of work done by them they cause the most serious wastes of money. I have known lots of good pattern-makers that could and did turn out excellent patterns, and I believe I have appreciated their work; but the trouble with quite a lot of them is that you can't get them to turn out anything else. Probably one-half of them have had this fault that I am telling about, and they have often sorely tried my patience. Pattern requirements are quite variable; the best patterns certainly are not required for everything, and the pattern-maker who can turn out nothing but the best all the time and for every purpose, is not the best pattern-maker. If his standard of work, supposing him to insist upon a uniform and invariable standard, is not sometimes too high, then it certainly is most of the time too low. No care can be too great in the preparation of standard patterns for permanent service; but there come also to most pattern-makers other jobs which, in the nature of things, are not so exacting. It is exasperating if you want a pattern for something not in itself requiring any precision or finish, which it is absolutely certain will never go into the sand a second time, and which, above all, you want in a hurry, to have to wait for all the routine puttering to be gone through with, just as though it was for the front of a new design parlor stove or the main casting of a type-setting machine. A pattern-maker who can gage his speed and style according to the needs of the case, is better than a better man who can only do his best. It is a great thing to be able to understand and appreciate what is wanted and to be able to do just that.

TECUMSEH SWIFT.

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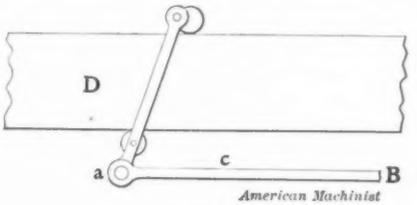
A Problem.

Editor American Machinist:

Each week I absorb the contents of the "American Machinist" with pleasure surpassing that with which I absorb ice cold liquid refreshments. Think of it!

Next to "F. J. M.'s" articles now appearing, I like the letters from practical men, and the occasional problems submitted. I desire to submit a simple one which I have had in mind for some time. In the sketch the rod *C* is connected to the source of power. It moves in the direction of line *A B*. It is desired to move the body *D*, which must be free to assume a motion much faster than that of *C* if necessary. Some such arrangement of the kind sketched is desirable, for the arrangement used must be of very simple construction. After *D* has received its



A PROBLEM.

motion from *C*, the device used to connect *C* and *D* must release automatically, either by virtue of the continued motion of *D* or a motion of *C* in the opposite direction. In no case must it be necessary to pay any attention to the releasing mechanism.

Probably cams would be the only means of accomplishing this, but will not "Quirk," "To-come-so" Swift, Morris Fulton, or one of those other wise men suggest something good and above all simple and of few parts.

R. G. PILKINGTON.

St. Louis.

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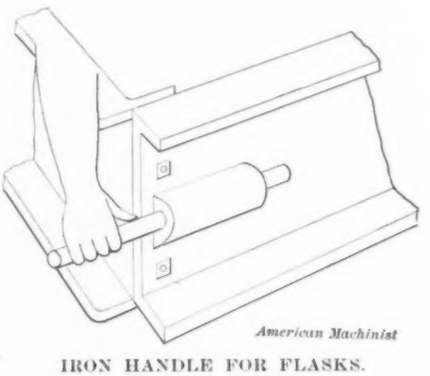
The sketch given herewith was accidentally omitted from Mr. O'Neil's letter



IRON HANDLE FOR FLASKS.

printed last week. It shows the handle for iron flasks which he referred to.

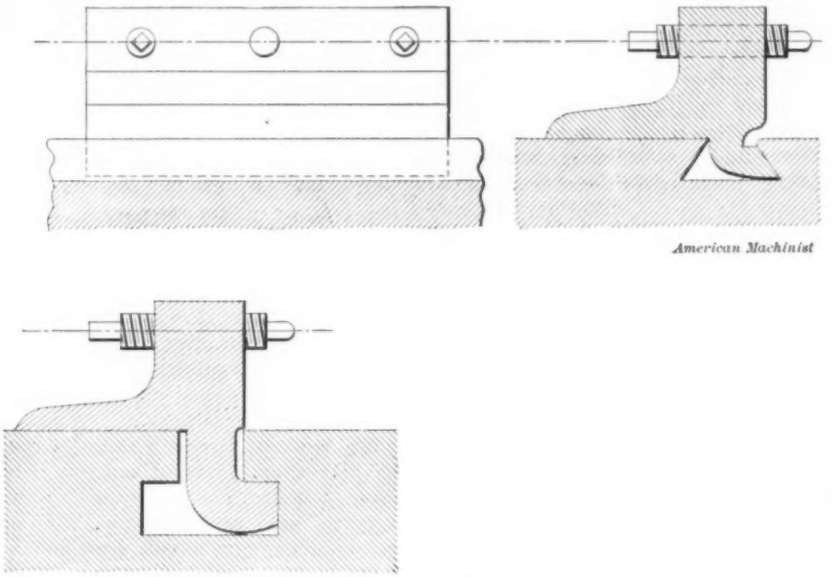
▲ ▲ ▲

Planer Attachment.

Editor American Machinist:

A neat arrangement of clamp and thrust-block for planers, shapers, drill-pieces, etc., is one which I saw recently in a shop in Loebtau, near Dresden, and which there takes the place of a planer-chuck or vise, etc. As shown in the sketch, it consists of a casting of L-section with a forward-projecting toe which engages in the dovetail or T-slot in the table and prevents motion either forward or backward. In the upright of this casting are three holes

tapped in a horizontal line, and through these pass as many hardened screws, each of which has one end rounded and left unthreaded, and the other end squared for a key or wrench. (Usually only the two end screws are used.) The piece does not reduce the hight of work which can be handled as a chuck does. The castings are usually of gray iron, although sometimes they are of Bessemer steel—which costs twice as much and is not, to my mind, twice as good. The sizes made run from 1 x 4 centimeters, equal to 4 x 1.6 inches, up to 20 x 8 centimeters, equal to 8 x 3.2 inches; and, as shown, they are made for both dovetail and T-slots. Franz Küstner, of Kaiserstrasse, Dresden, makes them.



American Machinist

DEVICE FOR HOLDING WORK ON THE PLANER.

ROBERT GRIMSHAW.

▲ ▲ ▲

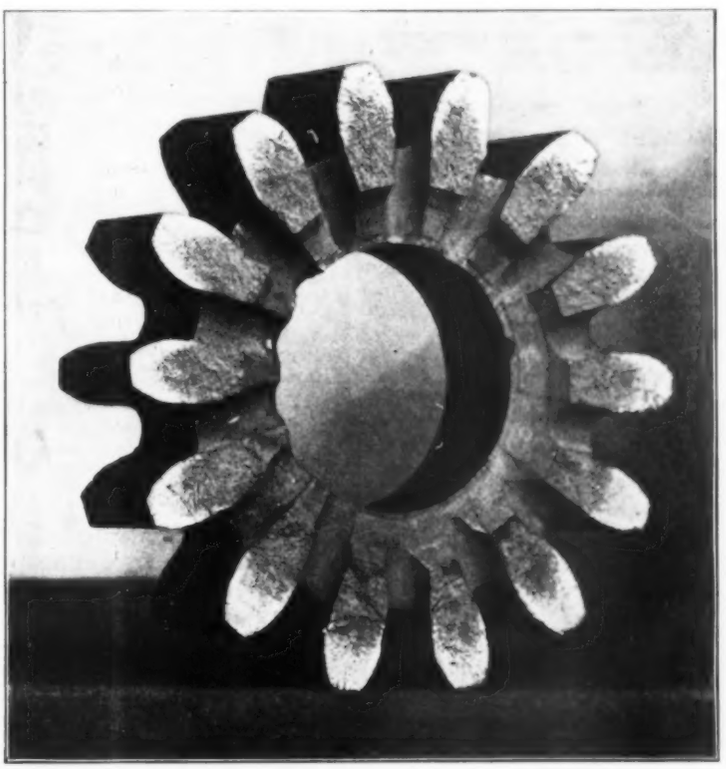
Gear Wheels with Chilled Teeth.

The process of casting in chills seems to have been applied successfully to the manufacture of gear wheels by J. H. Miller, of Newcastle, Pa., who is making such wheels under a patent granted to S. E. Maxwell, June 1.

The chill consists of an outer ring, to the inner surface of which are attached pieces projecting inwardly and the inner ends of which are formed to the required shape for the teeth. These constitute the chills, and the effect they produce upon the casting is shown by the accompanying photograph, in which, as will be seen, the outer surfaces and the ends only of the teeth have been hardened, the remainder of the wheel being soft and of course retaining its full strength.

The photograph is of a spur pinion which has been cast by this process, then chucked and a cut taken from the bore outwards as far as practicable, then holes were drilled radially between the teeth as shown and the gear split open by wedges.

Such wheels have been made and tested very thoroughly in trolley car service and have given excellent results, the teeth being not only hard but also accurately formed, and the gears being generally well formed and smooth running.



A GEAR WHEEL WITH CHILLED TEETH.

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Trial Run of the Hardie Compressed Air Locomotive.

On August 19th a trial trip, or more properly an exhibition trip, was made by the Hardie compressed air locomotive on the Manhattan Elevated Railroad in this city. The train started about 9 P. M. from the Rector street station and ran to Fifty-sixth street in nineteen minutes. The run was successful in every way, with the added and unusual features of no noise from the engine, no heat, no gasses, no smell, no cinders or other annoyances. On the return trip a stop was made at each station, showing complete control. The train consisted of three passenger cars and a baggage car serving as a buffet car. Those most interested in up-to-date modes of transit and the most prominent railroad officials and experts to the number of 190 enjoyed the trip. A series of most thorough tests of the Hardie system, under all the various conditions possible to occur, is now to be conducted.

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We noted in a recent issue the results of a motor carriage race in France. Since then another one has taken place from Paris (St. Germain) to Trouville. There were sixty-four starters, and the speed record was lowered, the 173 kilometers (107.5 miles) being made by the winner in three hours and fifty-one minutes, or about 28 miles per hour for the entire distance.

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The Ordnance Bureau of the War Department has awarded to the Bethlehem Iron Company a contract for the building of five disappearing gun carriages for 12-inch guns at $28,560 each. The firm noted made the lowest bid, and offered the quickest time. The first carriage is to be completed in four months, and one every five weeks thereafter. The carriages are swiveled for all-around firing.

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Locomotive Link Motion.

A communication was recently received by this office from Mr. J. E. Sague, mechanical engineer of the Schenectady Locomotive Works, offering the facilities of those works in the preparation of an article on the locomotive link motion. Inasmuch as existing books upon the link motion are either clouded with useless mathematics, or else represent ancient practice and give methods which are not actually followed in locomotive works, the invitation was looked upon as a very valuable one, and the beginning of the resulting article appears elsewhere in this week's issue.

The aim in the preparation of this article has been to faithfully present the actual practice of to-day, and as a necessary preliminary to that, to give a series of diagrams by which to demonstrate the action of the link. Such a subject is not capable of treatment by kindergarten methods, but the aim kept in view has been to adopt as simple methods as possible consistent with a proper degree of thoroughness; in other words, while the subject has not been simplified by ignoring essential features, it has been treated with as simple methods as possible, with the particular aim of presenting the link motion as it is built.

In the course of the investigation connected with this work, some interesting and entirely unexpected developments have been made. It is well known that in the adjustment of the link motion to give equal cut-off at the two ends of the cylinder, the saddle pin is located back of the link arc. Inasmuch as the connecting rod is known to have a distorting influence upon the steam distribution, it has been commonly, and we think universally, assumed that this adjustment of the saddle pin compensated the irregularities due to the connecting rod. In point of fact, however, other previously unsuspected errors exist, greater than those due to the connecting rod and of an opposite character; the real effect of the connecting-rod error being to partially compensate these others, and the real effect of the off-set of the saddle stud being to supplement the effect of the connecting rod, and so complete the correction. This is shown by the fact that if a link motion be laid down with the Scotch yoke connection between piston rod and crank, in order to do away with the connecting-rod error, the off-set of the saddle stud will be found to be greater than when the connecting rod is used; whereas if means be taken to obviate the other errors, but to include those due to the connecting rod, the saddle pin will be found to be located outside of the arc instead of inside, where it is actually placed.

A detailed discussion of these matters will appear in due course, and we think they will be of interest to all who are interested in valve gears. It certainly seems remarkable that these facts should have escaped attention, in spite of the fifty years or more of practice in link-motion construction.

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For the Common Mechanic.

A prominent characteristic of the tool making work done in the American watch factories is clearly exhibited in the article by Mr. Cleaves, published in this number. A watch factory tool maker must of course be a skilled workman, but he usually avoids depending upon mere manual skill, and is much more likely to attain his marvelous results by inventing some fixture or process by use of which extreme accuracy is, so to speak, insured. His constant striving to obtain the greatest possible degree of refined accuracy teaches him the important lesson that tools will go more or less wrong if they are given the chance to do so; and a large share of his consumption of grey matter is devoted to scheming fixtures and methods which absolutely compel the required degree of precision. A large proportion of the devices shown by Mr. Cleaves from time to time in our columns are of this character, and though they are based upon watch factory methods and are often given as merely incidental or tributary to other things, they are yet very well worthy of the most careful study by those who may wish to be able to do a job of work to any required degree of refinement. The names of other contributors will readily occur whose articles are equally valuable and suggestive.

We are not among those who seem to believe that men can be taught trades by the pen, or in any way other than by actual practice; but a man who has acquired the use of tools, and knows how to perform the regular machine-shop operations in a skillful manner, can then learn much more than these by simply reading clearly written and illustrated accounts of how skilled men have accomplished certain results.

No man can become a skilled surgeon by reading accounts of surgical operations; but one who is already a skilled surgeon, made so by practice, can, and, as a matter of fact, usually does, add very much to his skill by simply reading accounts of others' surgical operations. It is precisely the same with mechanical operations; there are things which cannot be learned by reading about them, and we do not consider it worth while to waste space in attempts to teach them. There are those who, because we do not undertake to tell our readers how to file, drill, plane and turn, seem to think we "publish nothing for the common mechanic." As a matter of fact, we publish very much of the only kind of articles that can do the common mechanic any good whatever—i. e., articles which, if he reads them, will help him to make himself uncommon.

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Chainless Wheels.

There is a general belief that one of the large bicycle concerns is preparing a chainless surprise for the next season. It has sent out a circular description of a recent hill climbing contest at Catford Hill, England. Of the thirteen skilled riders who started only two reached the top, and then H. J. Herbert astonished the crowd by riding backward up the hill on a chainless machine, which, after all, may not have shown the superiority of the machine. Professor Carpenter has made a comparative test of the two systems, and of ten different chain machines, the poorest of the lot showing less friction than the chainless wheel. But he had not got hold of the chainless machine which is still coming, and questions of strength and wear are probably of greater

importance than minute differences of friction.

We are inclined to believe that it is not going to prove so easy to supplant the chain as many people suppose, and that the extreme refinements of gear-making that are so much referred to in connection with cycles do not go well with a non-rigid frame, which is what a bicycle frame must be if it is of ridable weight. We also think that when it has been demonstrated that gears afford a better means of transmitting motion from cranks to rear wheel than a chain does, it will not be at all difficult to produce the gears of a quality fully up to the requirements of the case.

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We are hearing very much just now about the alleged rascally proceedings of certain patent attorneys. It is yet too early to form an opinion regarding the matter, because up to this time only one side of the story has been heard. But it is plain that those patent attorneys who publish some sort of a fake journal as an annex to their patent business have a great advantage in the controversy, and some of them whom no well-informed inventor would think of employing as an attorney, are editorially assuming an air of superior virtue that is simply ridiculous to one who knows something of the facts regarding the wholesale patent factories and their methods.

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We recently described in our columns some cast-iron milling cutters which are in constant use and are doing satisfactory work in a manufactory of hardware specialties. An enterprising contemporary now mentions the cutters, and says they do as good work as steel, which seems to be rather overdoing the matter. It was asserted that they last longer than steel cutters and are, of course, cheaper, and they do "good enough" work when they are used; but steel cutters are in no more danger of being driven out of business than the steam engine is.

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When are we to have aluminum coins in our pockets instead of copper and nickel, especially copper? The United States Government has gone far enough in its investigations to demonstrate the entire feasibility of the substitution. Aluminum for coin is extremely desirable for sanitary reasons, as well as for its lightness. The matter of aluminum coinage has been reported upon by the Congressional Committee on Coinage, Weights and Measures, and in view of its report, it is very likely that some action will be taken at the next regular session of Congress.

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There is now a machine for lathing. It will put the lathes on the inside surfaces of a house at the rate of 1,500 an hour.

Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer questions by mail.

(125) W. H. B., Brooklyn, N. Y., asks: With what velocity should the air travel through the inlet and outlet valves of an air compressor, or what should be the ratio of valve area to piston area, or what should be the area for short stroke and high rotative speed; also, what would be a safe working pressure for each valve? A.—To secure the best results, the piston speed should not exceed 300 feet per minute, and for a small compressor it would be better to have it lower than that. Then for the inlet valves, allow one-twentieth of the area of the piston. As the outlet valves would pass a much smaller volume, according to the air pressure, their area may be less than that of the inlet valves. One-half the area of the inlet valves would be a liberal size for the common working pressures. The valves should be safe, if properly made, for any pressure required. If more than 75 or 80 pounds gage pressure is needed, two-stage compression is more economical and desirable.

(126) J. H. B., Anderson, Ind., writes: I would like your opinion as to which way the thread should run on a bicycle pedal pin, when it screws into the crank and has no check nut. I have heard many arguments on this question, and practice varies. In most wheels, however, the right-hand pedal pin is threaded right hand, and vice versa; but it is evident that if the pedal of such a wheel be blocked in the pin and then revolved as it is in use, the pin will be screwed out, whereas if threaded the other way, it would be screwed in. Please explain. A.—You will find this matter fully treated by an illustrated article on page 535 of last year's volume, by S. W. Balch. The friction of the pedal upon the pin is not sufficient to be the controlling force; but the action which takes place is explained by what Mr. Balch calls the wabble theory. Its action will be understood, perhaps, if you insert a lead pencil in the neck of a bottle and then "wabble it" slowly, noting which way the pencil rotates on its own axis.

(127) G. C. T., Newark, N. J., asks: What is the way to get into the Engineer Corps of the Revenue Cutter Service, and what is the pay? A.—The United States Treasury Department has issued a circular (which anyone may have upon application) stating the requirements for admission to the service. The examinations are strictly competitive, and no political influence is necessary. Any young man who fulfils the requirements may obtain an examination. The salary of a Second Assistant Engineer is $1,200 per year; First Assistant, $1,500; and of a Chief Engineer, $1,800. The allowance for rations is thirty cents per day, as in the navy. On detached service, where no public quarters are provided, an allowance is also made for commutation of quarters. The positions are for life, with dismissal only for incompetency or bad conduct. There are thirty-six vessels, and the usual term on a vessel is three years, when the officer is detached and assigned to another. There were recently three vacancies in the list of Second Assistant Engineers.

(128) J. J. S., Lowell, Mass., writes: I am running a double-stroke air compressor—that is to say two pumps, one on each end of a shaft. The pistons are 1 inch diameter and the stroke is 6 inches, running about fifty revolutions per minute and keeping up a constant air pressure of fifty pounds. The piston packing is a cup-leather, with a steel washer behind nearly fitting the base, and a washer setting into the cup on the other side with a nut to tighten it up. The cylinder is water-jacketed, but the piston packing gives out and requires to be renewed about once a week. Would like to know of some form of piston that would not cause so much trouble.. The pump takes about one-quarter of a horse-power, and I would not want it to take much more than that. A.—The leather probably burns out by the heat of the air when compressed. The water jacket, while it cools the barrel, cannot have much effect in protecting the piston packing. Metallic packing should be used. Any packing which would be suitable for a steam piston would be preferable to the leather. Assuming the bore to be reasonably true, then a solid piston fitting as perfectly as possible with a single iron ring sprung into a groove, or two such rings, should give good results. If the pistons are single acting there should be no difficulty about oiling the cylinder surfaces, which should be done occasionally by some means. The pump probably now uses nearer a half than a quarter of a horse-power, and the metallic piston should not increase the power required.

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Personal.

Passed Assistant Engineer W. M. McFarland, U. S. N., is ordered to the Bureau of Steam Engineering.

Prof. D. S. Jacobus succeeds the late Prof. De Volson Wood in the chair of engineering at Stevens Institute.

E. H. Randall, who was formerly in the small-tool business in Chicago, has again started in much the same line.

Assistant Engineer E. F. Eckhardt, U. S. N., is detached from the New York Navy Yard and ordered to the Massachusetts.

Assistant Engineer C. R. Emrich, U. S. N., is detached from the Massachusetts on relief and ordered home. He has leave for two months.

It is reported that Naval Constructor Hichborn, Chief of the Bureau of Construction and Repair, will be reappointed upon the expiration of his present term.

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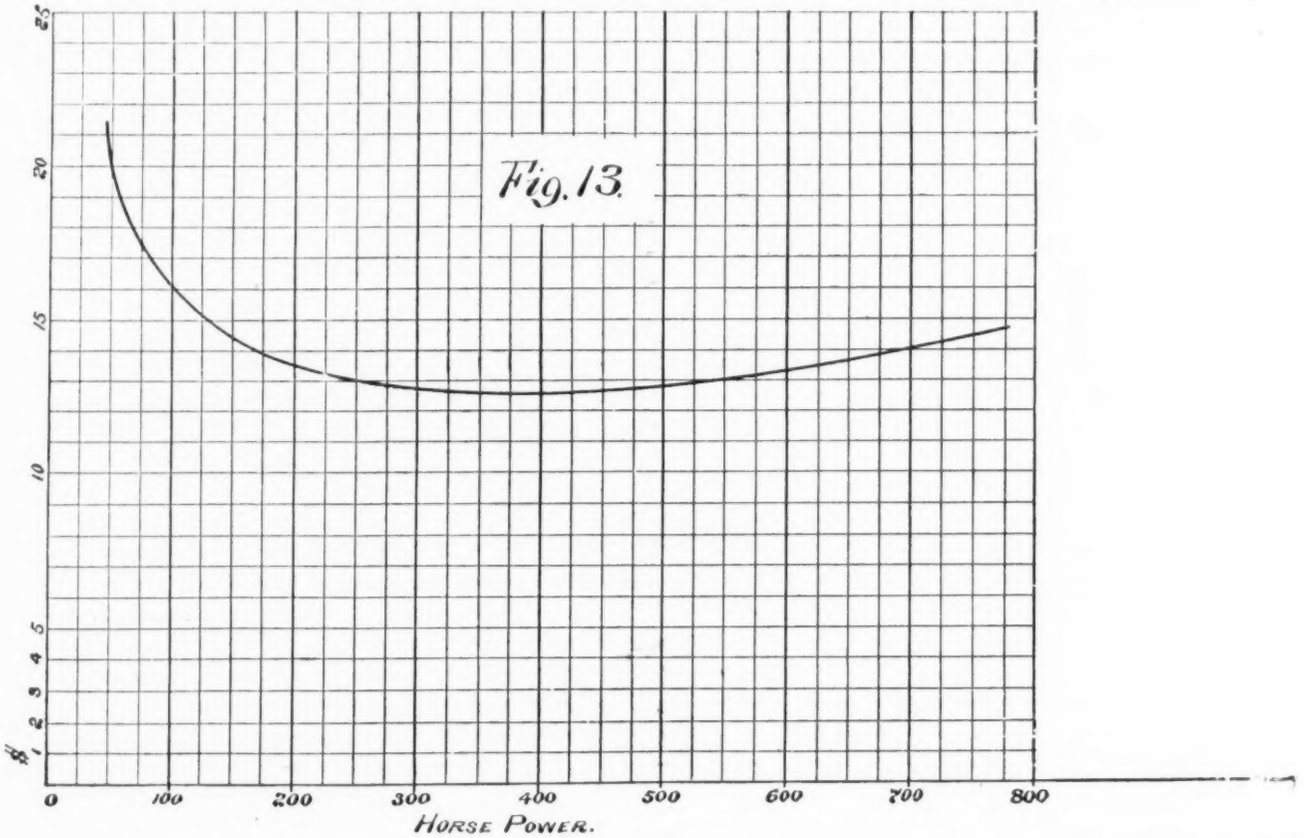
Obituary.

E. H. Easterbrook, division master mechanic of the Union Pacific Railroad, was shot by a discharged employé on the 16th inst. at Ellis, Kan.

Col. James R. Haskell, inventor of the Lyman-Haskell multi-charge gun, died at his home, Passaic, N. J., August 16th, aged 65 years. The gun, patented in 1857, was bought by the United States Government for $100,000, but was never used. It had been shown that in the ordinary cannon, where the shot was projected by the explosion of a single charge of powder, the initial strain upon the breech was enormous, and it was argued that if

a succession of explosions could be produced as the shot advanced, the same acceleration might be secured with less strain, and the gun was designed upon this idea. The shot was put in with but a slight charge behind it, and as it passed the mouths of the several powder pockets charges therein successively exploded, each one increasing the velocity of the shot. The guns showed remarkable results in penetrating armor; but the development of the slow-burning powders was probably the reason for its final abandonment. Mr. Haskell spent most of his life in perfecting and promoting his invention. For the last few years he had been both physically and mentally feeble.



Technical Books.

We have received Part 6 of "Easy Lessons in Mechanical Drawing and Machine Design," by J. G. A. Meyer, and find it fully up to the high standard set by the earlier numbers. This number is devoted partly to the treatment of geometrical problems arising in mechanical drawing and also gives some practical exercises in machine design, including the slide-valve and eccentric. There is also a drawing of a 4 x 6-inch vertical stationary engine. Arnold Publishing House, 16 Thomas street, New York.

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Relation of Cost to Power of Engines.

The diagram shows the relation of cost to power or size in two classes of the Buckeye engine. Horizontal distances, as shown at lower line, represent horse-powers, and vertical distances to the curve represent relative costs of the engines per horse-power. It will be seen that the curve is nearest to the horizontal line at 300 to 500 horse-power, showing that our 300 and 500 horse-power engines are sold at lower prices per horse-power than engines of either higher or lower powers. Engines of lower powers increase rapidly in cost per horse-power, while engines of higher powers increase less rapidly.

It is probable that this curve owes its shape somewhat to the character of our facilities, yet it can hardly be doubted that, in a general way, the relative cost as expressed by some similar curve would apply to other manufactories.

In considering the first cost of an engine, the curve shows that two engines of 300 to 500 horse-power each will cost less than one engine of twice this power; moreover, when two such engines are coupled at 90 degrees, with the driving-wheel between them, the absence of pillar-blocks and the reduced weight of the fly-wheel, which we have before referred to, make the plant still cheaper to construct; moreover, the absence of dead-centers is an advantage which engineers appreciate. The fact that large engines are more economical of steam than small ones can hardly be referred to as an offset to this, for a 300 to 500 horse-power engine is large enough to give as good results as may ordinarily be obtained.

It will be understood from the foregoing that we favor dividing the power where it may be done in the manner explained.

In case of compounds, the same advantages may be derived by using a cross-compound where the power required is as much as twice 300 to 500 horse-power. Notwithstanding the increased number of parts in such a construction, yet the two engines are produced at less expense than a single tandem engine of equal power.—Advance sheets, Buckeye Engine Company's Catalog.

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Within a short time the long talked of pneumatic despatch system between the New York and Brooklyn Post Offices will be an accomplished fact. The tubes for conveying postal matter from one city to the other are now being laid. The line will extend from the New York Post Office up Park Row and over the Brooklyn Bridge to the Brooklyn Post Office. The Ingersoll-Sergeant Drill Company, of New York, is furnishing the air compressors to supply pneumatic power for the purpose. They will also supply compressors for the plant being installed in Philadelphia. The Batcheller despatch apparatus is the system employed, and it will probably be extended throughout all of the cities named.

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Commissioner of Patents Butterworth is conducting a quiet investigation of the methods of patent attorneys, and has determined to weed from the lists all who are guilty of unprofessional conduct. All attorneys doing business with the Patent Office have been required to register their names. The Commissioner, if it is found

to be necessary, will call upon Congress for further authority, which will enable him to purge from the rolls those who use the privileges of the office to impose upon applicants for patents, and who take fees for services far worse than worthless.

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Bids for gun forgings opened by the Ordnance Bureau on August 18th were as follows: For 79 sets of field-gun forgings the Midvale Steel Company bid 32 cents per pound, and the Bethlehem Iron Works 33 cents. For 30 sets of 3½-inch mortar forgings the Midvale company bid 60 cents per pound and the Bethlehem company 65 cents.

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Double-Drum Trolley Driver—Improvised Universal Coupling.

Having occasion to drive a traveler for carrying kettles of melted asphalt, some means had to be devised for starting them without perceptible jerk that might spill the hot asphalt. It was decided to use the double-cable method, one cable raising the load to the traveler, and then running through the sheaves, while the other cable pulled the traveler along.

The hoisting cable was to be overhauled by the weight of the kettles. The traveler or trolley was to have a positive movement by the bight of the cable being made fast to it, both ends thereof being carried to and made fast, in opposite directions, to one of the drums shown in Fig. 1; the other drum doing the hoisting.

The driving was all done by three belts, the two outside ones running in the same direction, the middle belt running the other way, as shown by the arrows. The two intermediate pulleys were made fast to the shaft, which was worm geared to the drums, as seen in Fig. 2; the pulleys *a* and *b* being fast to the shafts, as shown, and pulleys *c d* and *e* running loose thereon.

The shaft was cut in two at *f*, as shown, and the ends supported in one of the tight pulleys, which was made fast to the shorter piece. The cast-iron housing was designed not only to support the worm gearing and the drums, but to form a sort of oil well in which the worm gearing was to run. The dotted lines underneath the gears show where the casting was cored out to allow the gear to be inserted before the drum shaft was put in; the downward projecting hooks were to go over the sides of the drip pans placed in the pockets.

The oil in these pans is carried so high that the gear dips into it, and is carried up to the worm, and, running back, must fall into the pan. Fig. 3 shows a side, or rather an end elevation of the rig, and it will be seen that the supporting frame or casting is carried all around the drums, making the device perfectly self-contained.

By referring to Fig. 2, the method of operating is easily understood. When it is required to raise a kettle, belt *e* is shifted to pulley *a*, and is shifted back at the instant the kettle gets high enough, and if it is not likely to stop soon enough, the belt is shifted over from *d* to *a*, just an instant, and forms a very effectual brake. As the hoist will stand in any position, however loaded, there is no need of holding anything after the drums have once come to rest, and the traveling can be proceeded with at any time. It is not even necessary to wait until the hoisting is finished.

By throwing the belt from *d* to *b*, the trolley is started along, and is returned by moving the belt from *c* to *b*. But three belts are necessary, and ordinary belt shippers are used for moving the belts, cords being attached in the manner usual to elevators, to allow the drums to be operated from various points and at a distance.

The worms and gears are about 4 and 7 inches in diameter, respectively, the drums being about 6 inches diameter by 18 inches long. The tight and loose pulleys are 2-inch face by 12 or 14 inches in diameter, and bushed with metalline.

Fig. 4 illustrates an improvised angle

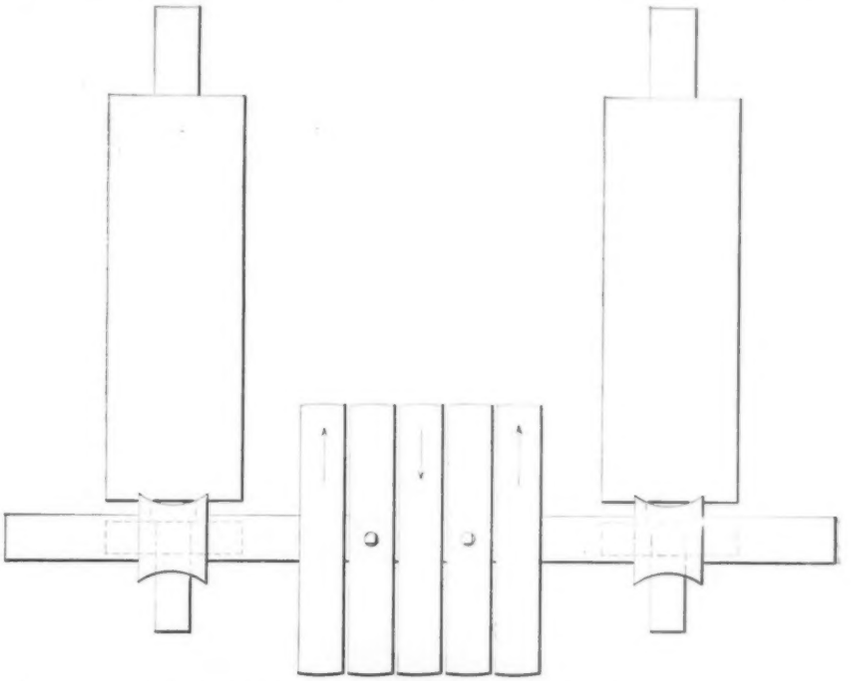

Fig. 1.—PLAN OF DOUBLE DRUM TROLLEY DRIVER.

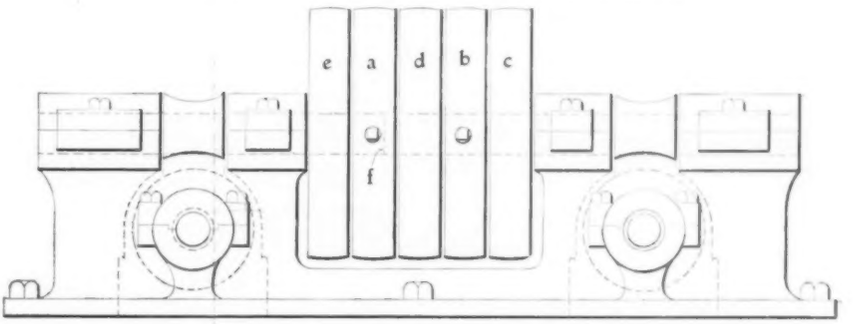

Fig. 2.—FRONT ELEVATION OF TROLLEY DRIVER.

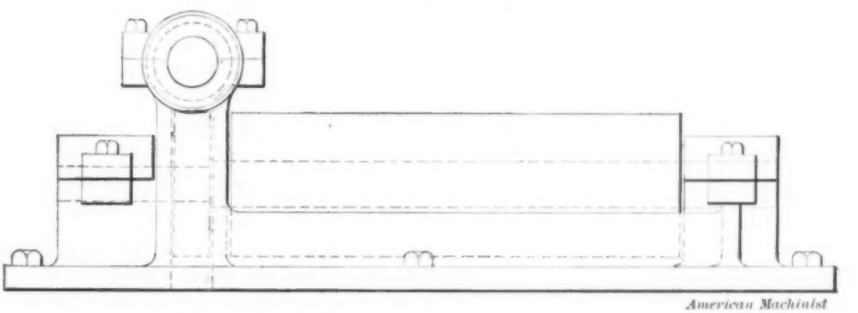

Fig. 3.—SIDE ELEVATION OF TROLLEY DRIVER.

coupling which was made up one day, in about thirty minutes, to help out in an emergency. The load was not great; all it had to do was to move the belt shifter on a pair of Evans friction cones. The left-hand member of the coupling is a common link belt sprocket wheel, having five or six teeth. This one has six.

The right-hand piece is a bit of steam pipe driven on a bushing which fits the shaft, and then the pipe is brazed, or pinned, to the bushing. The marking out was done by laying the sprocket gear on top of the pipe and marking around the teeth. Six cuts were then made with a hack saw, and three holes drilled through and squared up with a file, finished the job, which was a good one, and is running yet.

JAMES F. HOBART.

Brooklyn, N. Y.

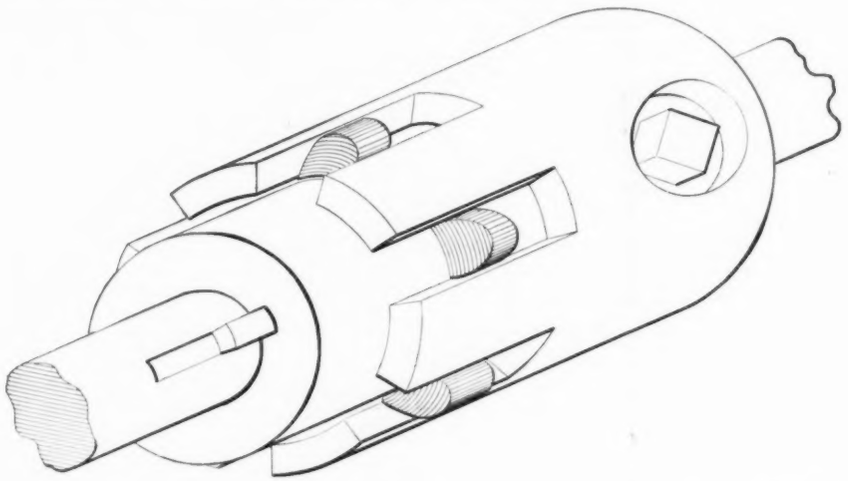

Fig. 4 *American Machinist*

AN IMPROVISED COUPLING.

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Died from Overwork.

A boy nine years old went into his father's room the other morning and found him dead in his bed. William Newman was employed in the molding shop of the Singer factory, at Elizabethport, N. J. For several weeks he had been working double shifts, or from six in the morning until ten at night, and all day every Sunday. He was not a dissipated man. He was anxious to build a monument to his dead wife and to give his son a good start in life. He and the boy lived practically alone and did nearly all the necessary housework, so that the result would seem to have been almost inevitable.

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We have received a book published by the Secor Marine Propeller Co., 100 William street, N. Y., which is issued as a prospectus of the direct system of propulsion of vessels, invented by John A. Secor. The method consists in the explosion of petroleum spray in tubes placed fore and aft in the stern of the boat below the water line. The reaction of the gas thus generated, against the water, imparts a forward motion to the boat.

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In 1860 the limit of boiler pressure on the Cunard steamers was 20 pounds, and the highest piston speed was 325 feet per minute. Vessels of the same line now carry steam as high as 180 pounds, with 805 feet for piston speed.

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It is said that a machine has been perfected by which some classes of glass blowing is successfully done, and that such a machine is in use in a Muncie, Ind., glass works.

Commercial Review.

NEW YORK, Saturday Evening, August 21.

THE MACHINE TOOL MARKET.

The past few weeks have included the typically dull period of the year. It is the annual resting spell for shops and business men generally. The works of one of the largest of the New England tool companies, for instance, closed for a fortnight at the first of this month, and a similar policy has, earlier or later, been more or less in vogue among others. The epoch of depleted office forces is not one in which the most radical improvement in general business is likely to appear, and the machinery market, notwithstanding that summer months have been known to be good ones in its line, is not the only pebble on the beach, and cannot begin a boom upon its own responsibility In fact, the testimony in local machine tool circles does not average into proof of a heavy volume of orders.

There is, however, enough evidence to lead one to believe that the trend of this department of busines is toward more activity. According to the statement of important houses the amount of prospective demand is growing, and although the change may be imperceptible from month to month and is more barren of results than one might wish, we believe that the undertone of the market is gradually strengthening.

The best thing to be said about machinery is the indirect influence which it, in common with all other lines of trade, is likely soon to feel from improved surrounding conditions. The buoyancy of Wall Street and of the Produce Exchange, where wheat has passed the dollar mark, as all of our readers know, are circumstances which are of more importance to tool builders than just how many lathes were sold last week or how many screw machines the week before, and they have much more to do with determining how many milling machines will be sold six months hence. The ray of hope in the mind of one tool seller, as he informs us, is the fact that so much gold has come into the country within the last year, which ought somehow to get afloat in business.

TOOLS NOW IN DEMAND,

according to the head of a prominent house, include notably milling machines and power presses. The latter are popular because of the present tendency to employ fittings for bicycles, etc., stamped from sheet metal, where formerly turned pieces were used. We do not hear that there are any large open contracts, such as that for the Port Royal arsenal, just now in the field. One house is figuring on a fat one, of which we dare say the particulars would be interesting, but they are "for members only." Elsewhere is reported an inquiry for tools for a concern which intends to manufacture bicycle balls.

THE PORT ROYAL CONTRACTS.

The proposals for machinery and machine tools to be furnished for the naval station at Port Royal, S. C., have resulted in the selection of machines to be supplied directly or indirectly by the Niles Tool Works, the Davis & Egan Machine Tool Company, Manning, Maxwell & Moore, the Hilles & Jones Company, and, probably others which have not been mentioned to us.

TYPEWRITER TOOLS.

It appears that the typewriter manufacturers are expecting better business, for it is said that most of the leading ones are buying new machinery. The Smith, the Remington and the Yost are doing so, as well as the Underwood and the Elliott & Hatch. That new company in Newark, the Manhattan, if they have not fulfilled anticipations, have ordered an engine, boiler and shafting, with some other machinery for their tool room. The main outfit of their shops will probably be obtained hereafter, if their plans are carried out successfully. The Mossberg & Granville Manufacturing Company, in addition to their line of machinery are entering upon typewriter manufacture.

EXPORT TRADE

is experiencing its ups and downs. They are not now all ups, as they seemed to

be rather less than a year ago. One of the downs, as noticed by some houses, is, that the English demand, as compared with that from Germany and France, is slack. Whether this is because less effort is being made by those parties with that country, or because it is approaching the point of saturation, is not obvious. The readiness with which the human mind traces the relation of cause and effect often shows more ingenuity than logic. A certain party remarked to an acquaintance of ours that the engineers' strike in England was hurting our trade; while another told him of having received a $14,000 order for machine tools from that country, which he attributed, in part, to the beneficial influences of the engineers' strike. Perhaps there is no confirmed and permanent cessation of the English machinery trade after all.

The representative of one company who are devoting themselves largely to European trade, remarks: "To tell the truth, we would prefer not to receive domestic orders, so long as we can get enough foreign ones to keep us employed. This we say, not from any spirit of independence, but simply because the prices of machine tools in this country are at such a low point that there is not enough profit in them to make it worth our while to build them."

The best proof of improvement in the machine-tool business will indeed be an advancement of prices. That stage appears rather millennial as yet. The ten per cent. wage advance just made by the

(*Continued on page 38.*)

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Business Specials.

Gear wheels, gear cutting. Grant; see page 16.

For pattern work write H. D. Phelps, Ansonia, Ct.

E. H. Randall, Tool Buyer. See page 9, this issue.

Machine Shop Equipments. York & Co, Clev'd, O.

Forming Lathes. Mer. Mach. Tool Co., Meriden, Ct.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N. Y.

Gear and milling cutters, adjust. reamers, counterbars and tools, vert. millers, drill pr., cutter and surf. grind., shears. R. M. Clough, New Haven, Ct.

Cost of Manufacturing—Experienced manager will establish system of costs, giving exact account of every detail. Charge based on saving effected. Correspondence solicited. Geo. C. Thomas, 99 Nassau Street, New York, Room 212.

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Wants.

Situations and Help Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than Saturday Morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Situations Wanted.

Mech. en., exp. sup. & head dr. Box 156, AM. MACH.

Eng. on orig. let. for typewr's. Box 167, AM. MACH.

Wanted—A situation as foreman. Address "E," 235 West Thirty-fourth Street, New York City.

Machinery designer, 6 years best exp., technical graduate, moderate wages. Box 148, AM. MACH.

Wanted—Position by draftsman, 6 yrs. exp., tech. edu., N. Y. or Brooklyn pref. P. D. Q., AM. MACH.

Pos. by mech. draftsman; exp. on wood working and gen. mchy; photographer. Box 166, AM. MACH.

Experienced all round mechanical draftsman desires position; moderate salary. Box 170, AM. MACH.

Draftsman and M. E. (Lehigh) desires pos.; 17 mos. exp.; salary mod.; best refs. Box 159, AM. MACH.

Mech. eng'r wants pos. as representative, estimating or as drafts.; 14 yrs. exp. Box 161, AM. MACH.

Change wanted by a successf'l gen. foreman; have held pos. with leading firms on Corliss eng., refrig mch'y and air compressors. Ad. Box 172, AM. MACH.

Draftsman, mech'l, with tech. education, wants sit.; 11 years' all around experience; also convrs. with civil eng. work. Box 158, AMER. MACHINIST.

Practical toolmaker and draftsman wants work; exp. in gun, sewing machine and typewriter work; experi. work a spec. Address Box 165, AM. MACH.

The supt. of a prom. mfg. institu. des. a change; can organize a factory and handle men to good advantage; thor. familiar with the des. and mfr. of bicycles; member of A.S.M.E. Box 147, AM. MACH.

Mechanical engineer (31) desires change; tech. edu.; good, responsible exp., steam and general mach.; competent to act as chief draftsman, engineer or manager's assistant. Box 169, AM. MACH.

Wanted—To change position as foreman machinist, tool maker or instructor in manual training school by a thorough and practical machinist and tool maker; seven years' experience as foreman; good execut'e ability; A1 ref. Box 144, AM. MACH.

Pos. wanted as supt. or general foreman by mechanical expert; large experience in shop management, up in mod. meth. and a pusher; Corliss and automatic engines, mech. tools and general heavy work; strictly temperate. Box 162, AM. MACHINIST.

To Manufacturers—If in need of, an educated, comp., prac. supt., manager or buyer, please correspond; exp. in wide line of work, from large eng. and boilers to fine light mchry; 15 years in charge of men; under 40. Address Box 168, AMER. MACH.

Help Wanted.

Agents in ev'y shop for "Which Way" Levels. Sell on sight. Write at once to E. G. Smith, Columbia, Pa.

Wanted—Manager to take charge of the plant of a well established manufacturing co.; must take a monied interest. Address Box 161, AMER. MACH.

Wanted—Mechanical engineer of large experience, competent to take charge of drafting department in an establishment building Corliss engines and employing several hundred men. Refenc. and record of services req. Add. Box 151, AM. MACH.

Wanted—A man competent to manage an electric repair shop; must be a good mechanic himself and have a fair technical education; one who is familiar with switchboard work or can develop the manufacture of special appliances preferred; state age and experience. Address Box 160, AMER. MACH

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Miscellaneous Wants.

Advertisements will be inserted under this head at 30 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d h'd lathes & planers. S. M. York, Clev'd, O

Calipers & Gauges. F. A. Welles, Milwaukee, Wis

The Dutton Wet Twist Drill-Grinder is sold by the Garvin Machine Co., New York City.

Best and cheapest Bolt Header, made by Baush & Harris Machine Tool Co., Springfield, Mass.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Boye, Cincinnati O

We make a specialty of Shartle's patent safety set collars. Prices low and samples free. Middletown Machine Co., Middletown, Ohio.

Patent right, special tools and machines for sale; good article to manufacture with other machinery. Box 146, AMERICAN MACHINIST.

For Sale—Small machine shop, having good repair trade, in town of 1,400 inhabitants; no opposition. Box 171, AMERICAN MACHINIST.

Model Locomotives—Complete castings, latest N. Y. Cen. standard, up to date; 4c. in stamps for cat. alog. G. H. Olney, 163 Herkimer St., Brooklyn, N. Y

Lathes, planers, drills, milling machines, vises, also brass working machinery second-hand; must be modern and in first-class condition. C. C. Wormer Machinery Co., Detroit, Mich.

For Sale or Rent—A foundry equipped for making light grey iron castings, with fine stock of patterns. A well fitted jobbing machine shop connected. Box 163, AMERICAN MACHINIST.

Wanted Capital, $10,000—A one-half interest in an established machine tool company is offered a practical man having the executive ability to conduct the business. Strictly modern shop and equipment with ample orders. Address Box 49, AMERICAN MACHINIST.

A machine shop, with modern equipment, heavy and light machinery, cranes of 20 tons capacity and 10,000 square feet of unoccupied floor space, would contract to manufacture any kind of machinery. Parties already having machinery built under contract might do well to write us for estimates. Box 62, AMERICAN MACHINIST.

One of the first machine tool factories of Germany wants the agency of a first-class American tool factory for Germany or the whole Continent. This factory sustains the best of relations to all the leading industrial works in Germany, as well as abroad, and can bid fair prospects of good business. Address Box 132, AMERICAN MACHINIST.

WANTED!

A second-hand Vertical Boring and Turning Mill; swing, 66" to 72", with 2 heads having independent automatic feed.

Address "ENQUIRER,"
Care American Machinist.

FINISHED CASTINGS

Shapes cast to exact size with holes, thread, etc.

Circular on application **H. H. Franklin Mfg. Co.**
Franklin Street, SYRACUSE, N. Y.

Diamond Machine Co.

Providence, R. I., U. S. A.

ELECTRIC LIGHT ENGINES.

Photos, Descriptions and Estimates for the asking.

W. D. FORBES & CO.,
HOBOKEN, N. J.
1302 Hudson St., 2 blocks from 14th St. Ferry.

(Continued from page 37.)

National Tube Works, is, however, not a gloomy sidelight upon the situation.

Quotations.

NEW YORK, Monday, August 23.

Iron—American pig, tidewater delivery:

No. 1 foundry, Northern	$11 50 @ $12 00
No. 2 foundry, Northern	10 25 @ 11 00
No. 2 plain, Northern	10 00 @ 10 50
Gray forge, Northern	9 75 @ 10 00
No. 1 foundry, Southern	10 50 @ 10 75
No. 2 foundry, Southern	10 00 @ 10 25
No. 3 foundry, Southern	9 75 @ 10 00
No. 1 soft, Southern	10 50 @ 10 75
No. 2 soft, Southern	10 25 @ 10 50
Foundry forge, or no 4, S'th'n	9 50 @ 9 75

Barn Iron—Base—Mill price, in carloads, on dock: Common, 1.00 @ 1.05c.; refined, 1.05 @ 1.15c. Store prices: Common, 1.25 @ 1.35c.; refined, 1.30 @ 1.45c.

Tool Steel—Ordinary sizes, standard quality, 6 @ 7c., with some grades perhaps a little less; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel—Ordinary brands, from store, in small lots, 1.40 @ 1.45c.

Cold Rolled Steel Shafting—Base size, in store, in small lots, 2 @ 2¼c.

Copper—Carload lots, Lake Superior ingot, 11¼c.; electrolytic, 11 @ 11⅛c.; casting copper, 10⅞ @ 11c.

Pig Lead—Carload lots, 3.90 @ 4.00c., f. o. b.

Pig Tin—For 5 and 10-ton lots, about 13.85c., f. o. b.

Spelter—Carload lots, New York delivery, 4.25 @ 4.35c., f. o. b.

Antimony—The range, according to brand and quantity, is 7 @ 8c.

Lard Oil—Prime city, winter make, commercial quality, in wholesale lots, 40 @ 41c.

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Manufactures.

At Franklin, N. H., John T. Bessom is building a shop.

The Waterville (Wash.) flouring mill was burned August 8.

The Indiana Fiber Company will locate their factory in Kokomo, Ind.

A $2,500 machine shop is in course of erection in Kennett Square, Pa.

At Reed City, Mich., the Lowell Manufacturing Company's plant is to be rebuilt.

The J. A. Sayward Lumber Company has decided to build a sawmill at Nelson, B. C.

The furniture factory of Black & Willard, at Buchanan, Mich., was burned on the 8th inst.

The Great Western Elevator Company is building a 35,000-bushel elevator at Henning, Minn.

The Rochester (Pa.) Olive Stove Works Company are erecting a large brick addition to their works.

F. T. Neeley is organizing a stock company to erect a sawmill, planing mill and ginery at Decatur, Ala.

At Buckland, Conn., the Peter Adams Manufacturing Company's plant has been destroyed by fire.

At Philadelphia, Pa., H. Stickner is having erected a factory in which paper boxes will be manufactured.

Edward Wertz, of Tulpehocken, Pa., is making improvements to his mill which will give it twice its present capacity.

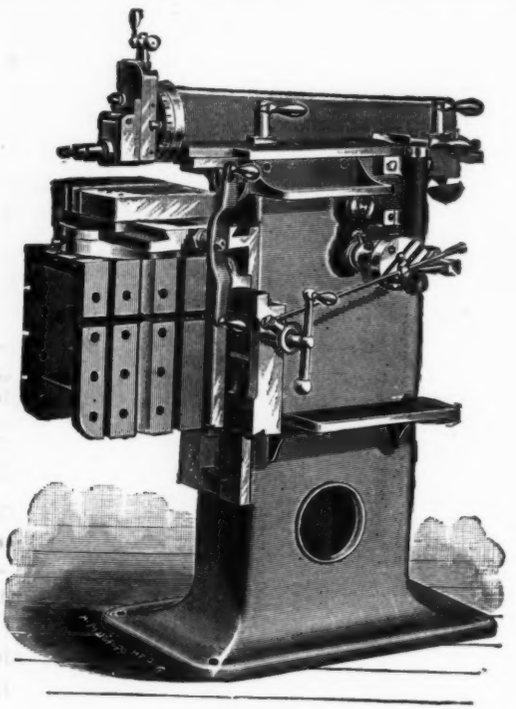
Joe B. Long, of Oliver Springs, Tenn., and other gentlemen interested with him propose to at once erect several large saw mills.

J. W. Bishop & Co., have been awarded the contract for a large addition to the H. N. Slater cotton mill at North Webster, R. I.

The Richard Manufacturing Company, of Woonsocket, R. I., is having its shop enlarged. The addition is to be 75 feet and two stories high.

Foley Brothers may build a new sawmill in St. Cloud, Minn., with a capacity of 100,-

(Continued on page 39.)



.. IMPROVED ..

15-inch Hendey Shaper.

Latest Improvements.
Useful Attachments.
Strong and Powerful.

...FOR...

Die Work, Tool Room or General Shop Work.

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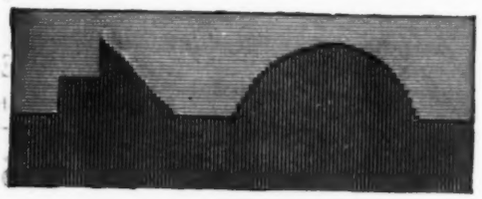
The stroke can be adjusted for curves with machine in motion. The stroke can be adjusted for angles with machine in motion. The stroke can be adjusted for irregular work with machine in motion. It has adjustable table for planing taper work; table can be removed for fastening work to apron. Has a strong graduated swivel vise. Quick work, rapid changes, modern ideas.



The cut shows how stroke can be adjusted with machine in motion by micrometer; adjustment fine and delicate. SEND FOR CIRCULAR.

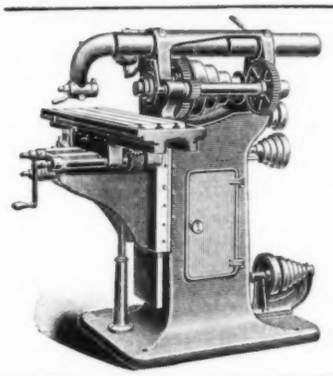
▲ ▲ ▲ ▲

THE HENDEY MACHINE CO.

TORRINGTON, CONN.

Agents for the Pacific Coast—PACIFIC TOOL AND SUPPLY COMPANY, San Francisco, Cal.

European Agents, { CHAS. CHURCHILL & CO., London and Birmingham. SCHUCHARDT & SCHÜTTE, Berlin and Vienna. EUGEN SOLLER, Basel, Switzerland.



COLUMN MILLING MACHINES

IN FOUR SIZES.

No. 0 and No. 1 with and without overhanging arm and back-gear. No. 2 and No. 3, shown in cut, have reversible feed. All have self-acting screw feed and stop motion, and tables have patent adjustable stop mechanism which prevents breakage of teeth when the work is run up to the cutters. Their stiffness and power fit them to do their work rapidly and smoothly, with long life to themselves and the mills.

Ask for Machinists' Catalogue.

THE PRATT & WHITNEY CO.

HARTFORD, CONN., U. S. A.

NEW YORK: 123 Liberty St. BOSTON: 281 Franklin St.
CHICAGO: 42 South Clinton St.
LONDON, ENGLAND: Buck & Hickman, 280 Whitechapel Road.
PARIS, FRANCE: Fenwick Freres & Co., 21 Rue Martel.

CATALOGUE FREE.

4 POINTS!!!! Design! Workmanship! Material! Finish!

All these are comprised in the make-up of our lathes and are the four necessary points in the construction of a good tool. Add to these a FIFTH and a very important one, the price, which we make very low to prompt cash buyers, and you have the story. Our Catalogue will tell you all about our Lathes, Planers, Shapers, etc.

SEBASTIAN LATHE COMPANY,

117 and 119 Culvert Street, CINCINNATI, OHIO, U.S.A.

FOR FOUNDRYMEN

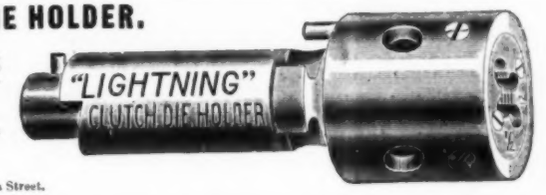
EACH,
12mo, cloth, $2.50.

WEST. "American Foundry Practice."
WEST. "Moulders' Text Book."
BOLLAND. "Iron Founder."
BOLLAND. "Iron Founder, Supplement."

JOHN WILEY & SONS, 53 EAST TENTH STREET, NEW YORK.

LIGHTNING CLUTCH DIE HOLDER.

For use in turrets of screw machines, screw plates, taps, dies, reamers, tap wrenches, bolt cutters, drilling machines, etc. SEND FOR CATALOGUE.



WILEY & RUSSELL MFG. CO.,
GREENFIELD, MASS., U. S. A.
Agents in London,
SELIG, SONNENTHAL & CO., 85 Queen Victoria Street.

DYER & DRISCOLL,

PATENT SOLICITORS, 31 NASSAU STREET, N. Y.

I have done all my patent soliciting work, both for this and foreign countries, continuously for the past fourteen years.

Thomas A. Edison

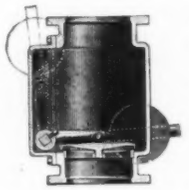
STAR LATHES

★ ★ ★

Foot Power Screw Cutting, Automatic Cross Feed, 9 and 11" Swing.

Send for Catalog B.

Seneca Falls Mfg. Co.
697 Water St., Seneca Falls, N.Y.



Excelsior Straight-Way Back Pressure Valve.

This valve has no dash pots, springs, guides or complicated levers to get out of order. It is simple, reliable and well made. Never sticks, and can be relied upon at all times when using exhaust steam for heating; or when used as a relief, or free exhaust on a condensing plant, it has no equal. It is noiseless and free from any complicated attachments.

JENKINS BROTHERS,

New York. Boston. Philadelphia. Chicago.

Die and Tool Steel.

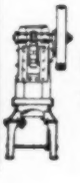
NO BETTER MADE.

CRESCENT STEEL CO.

PITTSBURGH, PA.
CHICAGO, ILL.
NEW YORK, N. Y.
DENVER, COL.

SEND FOR CATALOGUE.

Manufacturers of Set, Cap & Machine Screws, Studs, etc.



Drop Hammers, Presses, Special Mach'y Dies,

THE STILES & FLADD PRESS CO.,
WATERTOWN, N. Y.

(Continued from page 38.)

000 feet in ten hours, to replace the one recently burned.

Plans are being drawn by S. D. Lehr for a three-story brick addition, 50 by 150 feet, to the north side of the Palace Silk Mill in South Allentown, Pa.

The main building of the Southern Bridge Company's works, near the Southern Railway Shops, Birmingham, Ala., was destroyed by fire recently.

Henry Myers has leased the top floor of the Griffin Building, Cohoes, N. Y., and proposes to put in machinery to manufacture quilts and comfortables.

Contractor L. H. Focht has been awarded the contract for the erection of a large knitting mill at Norristown, Pa., which will be occupied by Rampo & Regar.

Improvements in the West Penn Hospital, at Pittsburg, will be begun at once by Superintendent Charles S. Howell. New laundry and other machinery will be installed.

The West Virginia Central Railroad is building a fourteen-stall round house at Cumberland, W. Va., and will remove their shops from West Virginia Junction to that point.

Shamokin, Pa., is to have a silk mill, Messrs. Kulp and Savidge have donated two acres and a half of ground, and a New York party is to erect the mill. It will be built this summer.

Ground is being cleared preparatory to work being commenced on a new 250 x 96-foot addition to the Putnam (Conn.) Manufacturing Company's mill. This means at least 600 new employes to the city.

The Nazareth Manufacturing Company of Philadelphia, Pa., has awarded the contract for a new mill. The new building will be of brick, three stories high and 101 feet by 42 feet in size, with an engine house 16 by 20 feet.

The Lehigh Valley foundry at Weatherly, Pa,. caught fire on the evening of the 10th at six o'clock and the building was nearly destroyed. The fire originated in the cupola. The damage will amount to several thousand dollars.

Mr. B. L. Case will erect a $20,000 factory building, at Toledo, O. Mr. Case is not a resident of the city, and Col. H. S. Bunker is looking after his interests. The building will be four stories high and of brick. It will be 100 by 128 feet on the ground.

The contract for the construction of nine buildings for the Stephenson Car Company has been awarded to Alexander Kerr, of Elizabeth, N. J., who will commence work at once. The buildings will all face New Brunswick avenue, and will cost nearly $300,000. The plant will employ 1,000 hands.

H. C. Bowen & Son, of Chestershire, Mass., will build a mill upon the site of the one recently burned. It will be modern in plan, and will have special facilities for handling grain to and from the cars. The building will be 30 x 40 feet on the ground, 50 feet high, with foot posts, elevators and other facilities.

The Deering Manufacturing Company has been organized at Portland, Me., for the purpose of carrying on a general manufacturing business, with $1,000,000 capital stock, of which nothing is paid in. The officers are: President, Joseph W. Fellows, of Manchester, N. H.; treasurer, Fitz H. Lan, of Gloucester, Mass.

An extensive steel and strip mill is to be erected at a point near Leechburg, Pa. When completed work will be furnished to several hundred men. A land company in the vicinity has donated a site. The company is composed of capitalists of Leechburg. They are Captain A. Hicks, J. W. Kirkpatrick and J. L. Kirkpatrick.

MODEL WORK.

We are prepared to assist the trade and inventors in solving mechanical problems, also manufacturing models and stock

CENTURY MACHINE CO.
576 West Broadway, New York.
Complete outfit of Modern Machinery and Tools.

ACCURACY

DON'T SPOIL IT
BY GUESSING.

Use the Richards' System of measuring machines; these Gauges are guaranteed to $\frac{1}{10000}$ of an inch.

Implements are adjusted at a temperature of 75°.

ASK FOR NEW RED BOOK.

The John M. Rogers, Boat, Gauge & Drill Works,
GLOUCESTER CITY, N. J., U. S. A.

ACCURACY ACCURACY ACCURACY

EASY LESSONS IN MECHANICAL DRAWING AND MACHINE DESIGN.

By J. G. A. MEYER.

Published in 24 parts, at 50 cents each. Sold by Subscription Only.

SIMPLE, THOROUGH and RELIABLE.

Intended chiefly for self-instruction, and is indispensable to all Mechanics, Engineers and those engaged as workmen, users or sellers of machinery. Agents wanted in all parts of the country. Young, energetic men to canvass the shop in which they work, preferred.

Send for Circulars.

ARNOLD PUBLISHING HOUSE,
16 Thomas Street, New York.

FOR PIPE.

THE ADJUSTABLE
"Duplex" Die Stock.
Quick, Accurate, Durable.
40,000 NOW IN USE.
THE HART MFG. CO.,
20 Wood St., Cleveland, O., U.S.A.
WRITE FOR LIST AND DISCOUNTS.

FOR BOLTS.

A PENNY SAVED IS TWO PENCE EARNED.

The Best is the Cheapest.

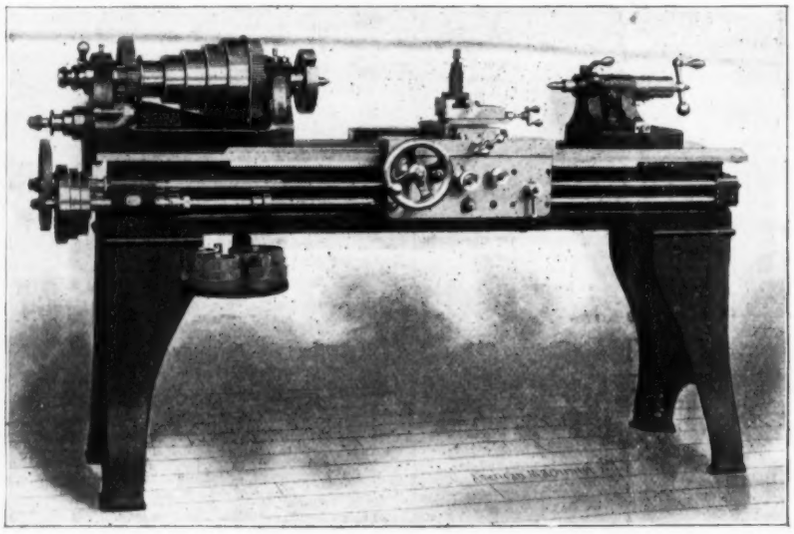
As a Money Saver our Safety Drill and Tap Holder is seldom equaled.

There are instances where it pays over ONE THOUSAND per cent.

It saves Time.
It saves Labor.
It saves Money.
It does its work Accurately.
It does its work Quickly.
It does its work Economically.

Is it not worthy of your consideration?

Write for Particulars. BEAMAN & SMITH, Providence, R. I.



It's a Flather!

When said about Lathes this remark means design, material, workmanship and conscientious painstaking with one end in view—the best lathe. To see one is to recognize at once these points.

Write to FLATHER & CO., Nashua, N. H., for particulars, cuts, etc.

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AGENTS:

Hill, Clarke & Co. { 156 Oliver St., Boston, Mass. / 112 So. Canal St., Chicago, Ill
Garvin Machine Co., 51 North 7th St., Philadelphia, Pa.
Niles Tool Works Co., 138 Liberty St., New York, N.Y.

FOREIGN AGENTS:

Adolphe Janssens, 16 Place de la Republique, Paris, France.
Chas. Churchill & Co., 15 Leonard St., Finsbury, London, E. C., England.
V. Lowener, Copenhagen, Denmark.

Something New. DRAFTSMEN'S DELIGHT
Sample 10 Cents. Try One.
JOS. DIXON CRUCIBLE CO.
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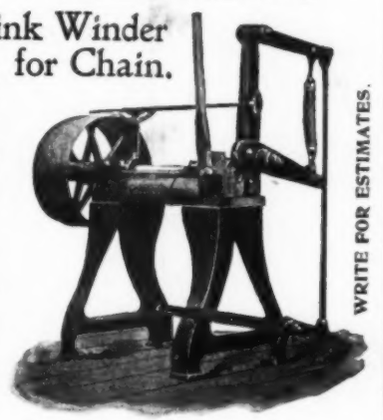
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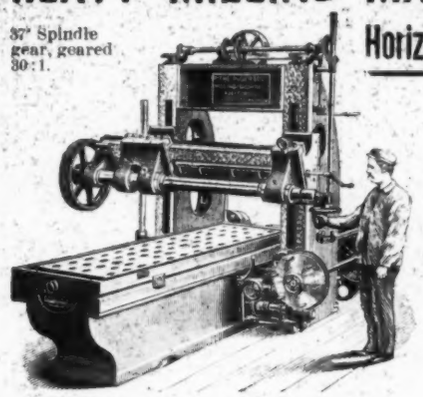

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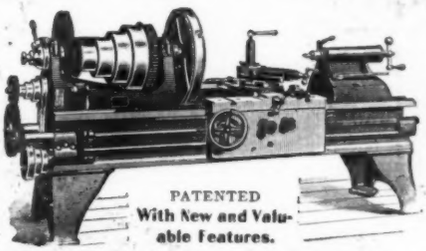

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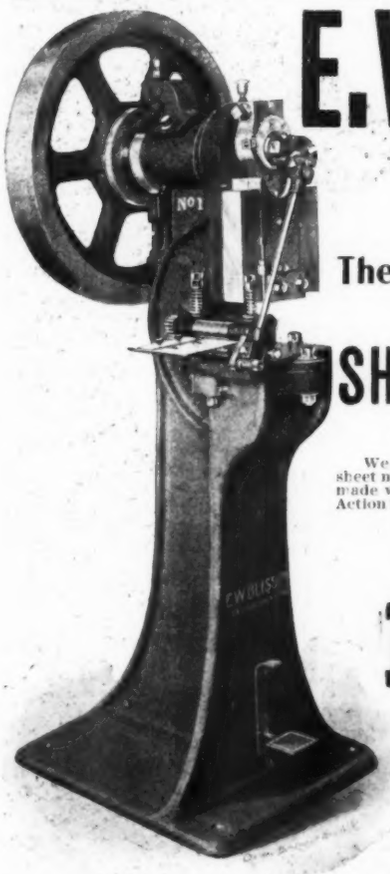

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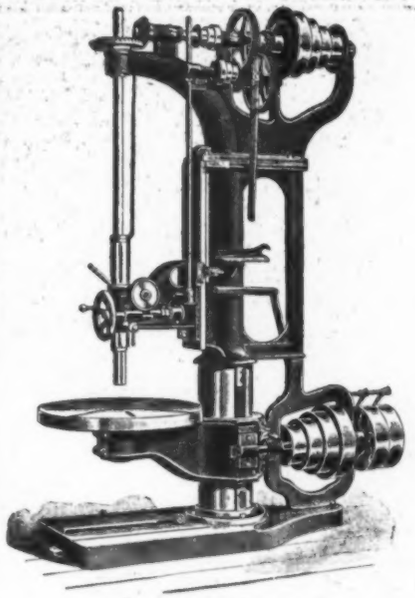

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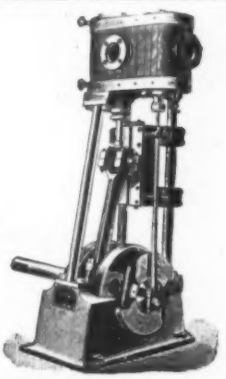

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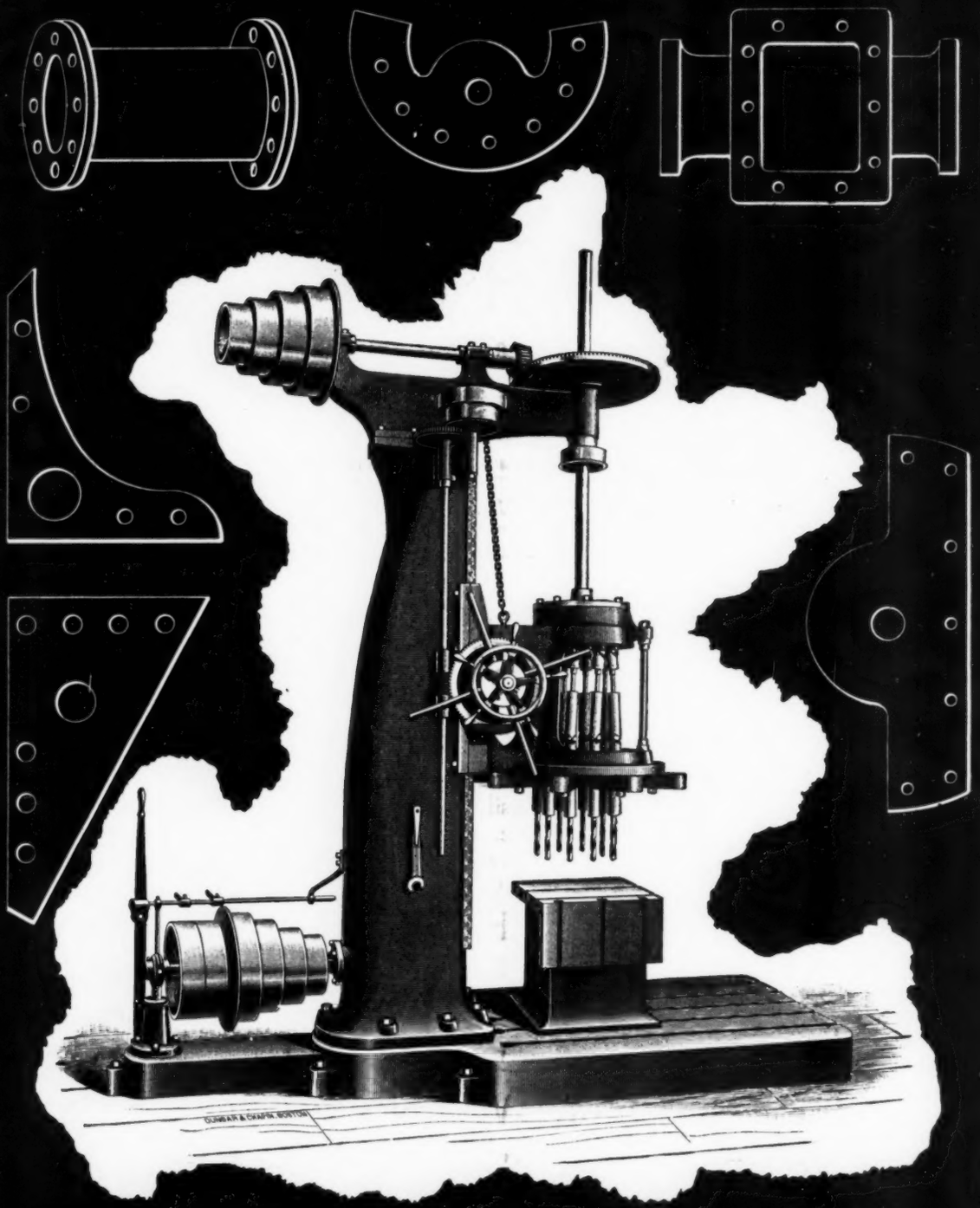

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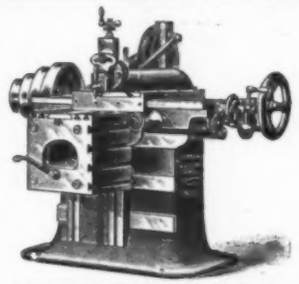

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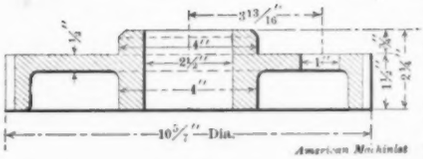

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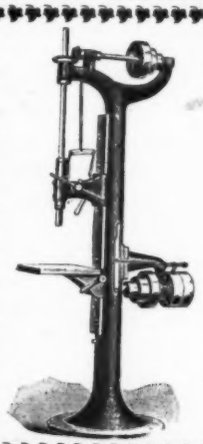

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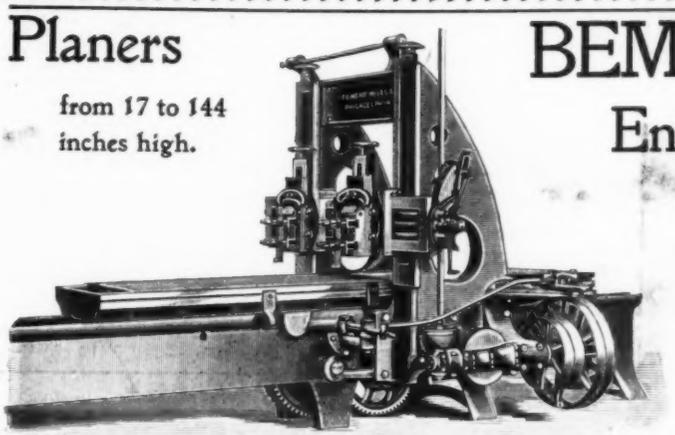

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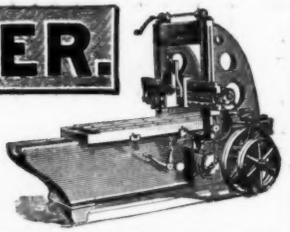

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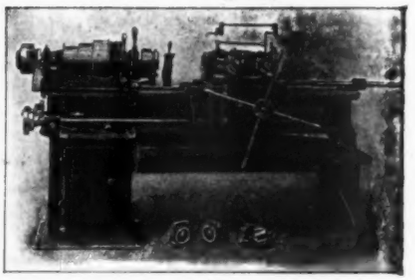

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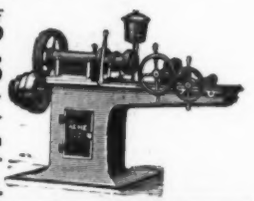

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